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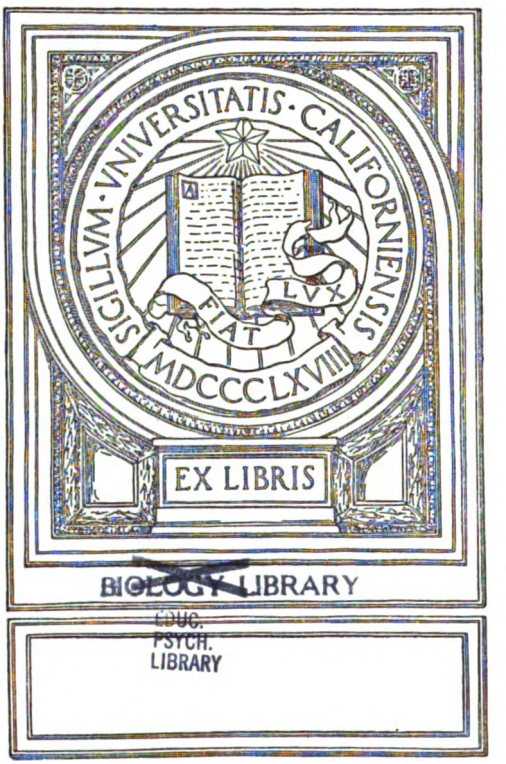

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RECENT PROGRESS IN PSYCHIATRY

INTRODUCTION

By G. W. T. H. FLEMING, M.R.C.S., L.R.C.P., D.P.M.,
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IT was felt that, having regard to the stagnation which is so apt to happen to everyone in wartime, the time was ripe to gather together information on recent progress in psychiatry and its ancillary subjects. It is 15 years since Henry Devine, whose early demise was such a loss to British psychiatry, issued his *Recent Advances in Psychiatry*. The period of time since then is too great to cover adequately with paper supplies restricted, so the present review is confined to work published during the five-year period 1938–1942, and in some instances the first half of 1943. It is hoped to make this review a quinquennial publication.

Owing to war conditions the continental literature has proved to be very difficult of access. Undoubtedly a number of journals have ceased publication, but it is hoped that when war conditions have ceased we will see the rebirth of all these journals. Several European countries, in peace time, were much better supplied with psychiatric literature than we are. For instance, there were some sixteen Italian journals dealing with psychiatry, etc., whereas in Great Britain there are only three!

Psychiatry has made considerable progress during the period under review, particularly with regard to treatment. Treatment by electric shock and by prefrontal leucotomy appear to have "come to stay."

The reconstruction period after the war may see a considerable development in mental health services, but here a word of warning may not be out of place. Psychiatry, with its ancillary subjects, is a very wide and difficult subject, and a sound knowledge of it is not to be gained by a six months' appointment in a mental hospital or clinic together with the possession of a diploma in psychological medicine. To-day psychiatry includes child guidance, which is rather a prophylactic measure, and criminology, but not every psychiatrist is going to possess a knowledge of the latter, although obviously everyone dealing with the psychological side of criminology ought to have a sound psychiatric training.

The training of the psychiatrist cannot be adequate in a period of less than ten years from qualification. It is a very difficult and complicated subject

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and requires years of constant experience and study, including long-section study of patients. The " born " psychiatrist is a *rara avis*.

The development of out-patient clinics combined with, in the general hospitals, beds under the control of a competent psychiatrist is essential to progress. These clinics ought as far as possible to be developed in connection with the universities, although in the provinces this may be very difficult. An Institute of Psychiatry situated in London would be a great asset.

When we come to consider psychiatry itself we find that some of the newer treatments have caused us to stop and consider whether our ideas about the physiology of the nervous system are as sound as we thought. Golla has pointed out that we have to revise our static ideas and look on the nervous system as much more fluid than we had imagined. Prefrontal leucotomy, which still comes in for a degree of thoughtless and ignorant criticism, is going to revolutionize the treatment of mental illness, but is still very much in its infancy, and there is a great deal to learn and a very wide field for investigation of some areas of the brain and some branches of psychology. Electric shock treatment has made immense progress, and is now the method of choice in convulsion therapy. Electro-encephalography has been of great service, and is only now developing as it ought to do. Grey Walter has recently made considerable progress in analysing the alpha rhythm of the EEG into three types. Types of thinking may in time be distinguished by investigating change in the electrical potential of the brain. In the pathological world progress is, as always, slow, but it is sure, and it is becoming realized how much pathology owes to microchemistry. The future holds out inviting prospects along many new lines, and it is to be hoped that psychiatrists will no longer reject pathology as a dead subject confined to the mortuary. There is a great future before it if only the new methods are used. The biochemical aspect, including both the endocrine and vitamin approaches, is coming more to the fore, and there is no question that a wide knowledge of all three subjects is an essential to the fully-trained psychiatrist. I would go so far as to suggest the inclusion in the Diploma of Psychological Medicine of a paper consisting of biochemistry, including the vitamins, and another on endocrinology. Unless a psychiatrist has a reasonable knowledge of these subjects he cannot investigate and treat cases adequately. Recent work in which the testis has been examined by biopsy by Hemphill at Bristol tends to confirm the work of Mott on the testis in schizophrenia, and an extension of this work with its obvious implication and application to child guidance work from a prophylactic viewpoint is one of the most urgent research problems.

The future of psychiatry is very bright, but there is a great deal of concentrated hard work and research required.

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MENTAL HEALTH SERVICES—PRESENT AND FUTURE.

By A. A. W. PETRIE, M.D., F.R.C.P.,

Medical Superintendent, Banstead Hospital; Lecturer in Psychological Medicine, Charing Cross Hospital.

THIS most important subject, which is likely to affect the whole future of psychiatry, has so far made little progress. Enlightened individuals are beginning to show a way, handicapped by existing law and practice. Some of the most important possible developments are not under the control of those with mental hospital experience, and the diversity of approach and training of those who deal with the different aspects of the subject renders co-ordination still more difficult.

The Beveridge Report and the consequent projected changes in the structure of general medicine makes consideration of the development of mental health of urgent and vital importance. Until recently the Minister of Health decided to exclude mental health from the anticipated reorganization of the Medical Services, but as a result of protests this decision has now been rescinded.

It is, therefore, necessary to prepare schemes for co-ordinating the work of mental health so as to fit in with the general health services of the country. While a great opportunity arises which it would be almost criminal to neglect, it is most difficult to formulate satisfactory plans while the future development of somatic medicine remains so nebulous. Any scheme needs to be elastic, and must indicate the lines of development suitable for a number of varying circumstances.

The form in which the structure of general medicine will take shape has several times shown signs of crystallizing, only to dissolve again into discussion.

A centralized State Medical Service arouses antagonism in some, owing to the fear that all medical men will become inarticulate and stereotyped civil servants, controlled from an imponderable department in Whitehall, where slow decisions may stifle initiative.

The opposite extreme is a medical service controlled by the numerous municipal bodies of very varying sizes, who at present largely control mental health activities. It is obviously impossible to develop a proper and complete mental health service in a small area, and there is a very real belief that local politicians of whatever shade of thought are not the best persons to control medical affairs.

The discussions range between these two extremes, with plans designed to avoid petty biased interference on the one hand, while avoiding control which is entirely out of touch with local opinion and affairs. It seems, however, likely that a more co-ordinated medical service will develop, with some form of Central Health Board, with probably local counterparts.

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It is not the function of this article to consider how such boards should be constituted, or how medical representation should be effected, whether directly or by means of medical advisory committees. This major problem merely concerns psychiatrists as medical practitioners. It is, however, the duty of all psychiatrists to be ready with reasonably elastic plans, so that they may be in a position to advise how their services may be linked up with changes in general medicine.

Up to the present there has been little attempt to develop mental health services in Great Britain, and even now suggestions on these lines tend to arouse antagonism owing to the fear that the co-ordination of activities may limit the freedom of workers in different spheres, but the obvious need for the development of a policy for mental health is gradually becoming widely recognized, so that mental medicine may take its proper part in the preventive health services of the country.

Two recent reports lay down at considerable length the reason for mental health services and indicate their functions, and describe in detail the activities they should undertake, and subsequent conferences have generally come to similar conclusions.

The reports in question are those of the Feversham Committee on the Voluntary Mental Health Services and the Report of the Committee on Mental Health of the British Medical Association. The Feversham Report was originally conceived with a view to bringing together on a rational basis all the voluntary mental health services of the United Kingdom, but enlarged its terms of reference as follows:

> "To consider the scope and activities of, and the law affecting the existing voluntary organizations, rendering mental health services; and to report upon the possibility of increasing their usefulness to the community, particularly in relation to—
>
> "(1) Their co-operation with Government Departments, local authorities, and other bodies interested in mental health work;
>
> "(2) The co-ordination of their activities, and—
>
> "(3) The extension of the services rendered by them."

The British Medical Association's terms of reference were wider:

> "To inquire into and report upon the present medical equipment and provision for dealing with mental health in this country, with particular reference to the problems of the treatment and prophylaxis of the psychoneurotic and allied disorders."

They also considered the teaching of psychological medicine, and the extent of the various forms of mental health, the various forms of treatment, and the need for the extension and improvement in institutional and out-patient treatment.

The Feversham Report naturally emphasized the importance of the voluntary associations, and their role in leading development. One result of the report has been that a Provisional National Council for Mental Health has been formed, incorporating the Central Association for Mental Welfare, Child Guidance Council, National Council for Mental Hygiene, and the Mental Health Emergency Committee. The new National Council are now publishing a

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journal entitled *Mental Health*. The only important group which did not join the new Council is the Mental After-Care Association.

Since these reports were published, other bodies have considered the future developments of psychiatry. The Royal College of Physicians have set up a committee which, although principally concerned with teaching and diplomas in psychological medicine, is also considering the future developments in psychiatry. A Planning Commission of the Royal Medico-Psychological Association has prepared a report which has just been presented to the Ministry of Health. A Joint Committee of the Mental Hospitals Association, of the Royal Medico-Psychological Association and the Hospital and Institutional Workers' Union has also prepared resolutions for submission to the constituent bodies. More recently a Conference of Psychiatrists has been held under the auspices of the Psychological Medicine Group of the British Medical Association. A report has been prepared which is still under consideration by that Association. Any such report is likely to be based on the previous *Grey Book on Mental Health* prepared by the British Medical Association in 1939 and published in 1941. Recent developments, and particularly in the field of preventive medicine, are, however, likely to receive attention. Surveys, both official and unofficial, have been made recently. Surveys for the Nuffield Trust have been made in the Oxford and other areas, and it has been found that much can be done simply by collaboration under present conditions. The Neurosis Survey for the Ministry of Health should determine the necessity both for the in-patient and out-patient treatment of that section of the work. In some areas attempts to work out detailed schemes of progress have been made, but these have yet to reach the stage of public discussion.

Having considered these developments, it will be necessary to state briefly the present general position before outlining the various projects which are likely to be suggested for the future.

Whether one assumes that regional areas will be developed under a central control, or whether one envisages a collaboration of local authorities, it is likely that health regions of reasonable size will be formed.

In any such areas there must be general hospitals, presumably with medical schools and associated with universities. There will be mental hospitals, registered hospitals and licensed houses. It is quite probable that early treatment clinics for neurosis and early psychosis may exist or may arise. In the urban areas acute cases may be received into observation units, which may be situated either in municipal hospitals or public assistance institutions. Psychiatric out-patients may attend either at the general hospital, or some special clinic, or at the mental hospital.

Child psychiatry needs to be fitted into any scheme of this nature. The mental aspect of the child is dealt with by the school medical officer, who is responsible for ascertaining the defective. The work may or may not be associated with those who are responsible for looking after the defective when he needs care in a mental deficiency institution, and even now the anachronism of mental defectives being cared for in mental hospitals has not entirely been eliminated. Again, special schools and training centres are now an attribute of the education services. Child guidance clinics for those who are mal-

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adjusted are a more recent development, and have developed in various ways, at times being attached to a general hospital, at times in specialized clinics, and sometimes in association with the educational department of the local authority. Before this war over fifty of these clinics were functioning. Enough has been indicated to show the need for a proper co-ordination of all these activities into a coherent whole, with a definite policy and direction. The diversity of practice will probably never become uniform, and solutions suitable for densely crowded urban districts may not meet rural needs.

Although large areas have a great opportunity for developing comprehensive services, it is smaller areas which have in some instances shown greater enterprise, mainly due to the fact that it has been possible for one person to initiate and develop the work. Oxford, Hertfordshire and Portsmouth are all examples of this type of development. Oxford, under Dr. Saxty Good, was one of the earliest places to demonstrate the importance of the out-patient department and its work. Dr. Kimber, of St. Albans, has shown how it is possible to link a great number of desirable developments with the mental hospital, and Dr. Beaton, at Portsmouth, has organized a mental health service with himself as chief officer.

All these activities naturally rather tend to centre around the mental hospital, and some would say that this is the proper line of development. Others would prefer the general hospital as the focal point, while others again would form a central mental health organization.

This last is more suitable for the larger areas, where there is more than one institution, and where it is less easy for one person to co-ordinate. With the development of mental deficiency institutions that type of work separates from the mental hospital. The same body may, however, act in each case, as in Kent, where the composition of the mental hospitals and the mental deficiency committees is identical.

Great variation occurs among the larger authorities, which in some cases form joint boards, as in Lancashire and Staffordshire, where county boroughs unite to form such boards with the County Council. The Ridings of Yorkshire provide a varying problem, the populous West Riding having five mental hospitals.

An even greater problem occurs in the London area, which has seventeen institutions, including nine large mental hospitals and seven larger and smaller mental deficiency institutions. St. Ebba's Hospital, which has recently been enlarged, now deals with recent cases of the voluntary and temporary treatment type, while the Maudsley Hospital only deals with neuroses or suitable recoverable acute psychoses, all on a voluntary basis.

In this superficial survey it will be seen that there is a great variety of procedure. In some areas the institutions are comparatively independent, merely representing geographical divisions of the same problem. The mental hospitals may be under a joint board, while mental deficiency may be controlled by individual local authorities. Only the County of Middlesex has tried the experiment of combining all its mental deficiency activities under one officer.

Enough has been said to indicate that there is a wide variety of procedure, with every kind of development and in some cases lack of development. The

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work at the general hospitals is often organized from the mental hospital, but in other cases it is quite unconnected, being controlled by those more interested in the study of the neuroses.

In the larger university towns the psychiatric clinic at the general hospital is usually controlled by the lecturer in psychiatry, who, in the provinces, is generally connected with the mental hospital, but in London is usually a practising specialist, sometimes, however, associated with a registered hospital or licensed house.

Coming to the local authorities, the connecting link between the areas and institutions is the clerk of the visiting committee, who may be the clerk of the county council. At times he has acquired great power, and in London was appointed Chief Officer to the Mental Hospitals Department. Successive lay officers did much to co-ordinate activities, but naturally did not represent a medical standpoint.

This has been followed in London by the whole department of mental health being placed under the medical officer of health. This is a most interesting development, which may prove successful, if the fusion of mental and physical health can be accomplished, while allowing a full development of the mental health problem. If such an experiment is to succeed it is likely that a full-time advisor in mental health will be necessary in any large area, developing and co-ordinating all the varied aspects of mental health. The advantage of such a fusion with physical health is obvious. A number of the services to be developed are already under the medical officer of health, who is the school medical officer. Child psychiatry both in respect to the aptitudes of normal children and in the ascertainment of mental defectives fall within his purview, and guidance for the maladjusted child is closely allied. In many cases the observation wards, where early acute cases are received, may be sited in municipal or county hospitals under the Public Health Department.

For these reasons it is clearly of primary importance to co-operate with the medical officer of health. There will be general agreement that close co-operation between mental health and the medical officer of health and the education department is essential. The divergency of opinion arises when details are discussed.

There is a considerable demand among psychiatrists that the mental health services should be under the command of a medical officer of mental health, and that he should take over the various functions at present appertaining to the medical officer of health and be of equal status with the medical officer of health.

To maintain a proper co-ordination all elements of health must be fused into a single entity, and given reasonable autonomous control of mental health, with expert direction, there appears to be no reason why mental health should not take its place as one of the great factors in the general health services of the country.

How is such a structure to be erected? Given reasonably large areas, it should be possible to devise an organization capable of co-ordinating all mental health activities, and providing new and enlarged facilities. The very varied services which will need co-ordination and control indicate the need for representation of different interests. It is suggested that a local advisory panel or

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committee should be formed to assist in the direction of this work. On this committee should be representatives of all types of mental health activity in the area, including those who practise in the fields of neuroses and child psychiatry, as well as representatives of all those who are mainly concerned with institutional work, such as medical superintendents of the county and borough mental hospitals and mental deficiency institutions, registered hospitals and licensed houses. Those engaged in the social services will also have a standpoint they will desire to present.

As indicated, the subject naturally divides itself into the group of child psychiatry largely centring around the educational services and including mental deficiency, and the group dealing with the treatment of actual neuroses and psychoses. Much of the psychological aspects of industrial medicine are comprised in the neuroses group, and general social medicine has important psychological aspects.

Dealing first with the group concerned with children:

A proper psychological assessment of the capacity of every child seems a desirable ideal. This would, however, be a great undertaking, and some proof of the benefit likely to be derived both by the individual and the nation would need to be demonstrated. To some extent this has been done by the assessment organization set up by the army and other armed forces by forming selection boards, but this principle has yet to extend to children. If all citizens were put to the type of work for which they were more suitable a great impetus would be given to national efficiency. It is suggested that research workers taking a small number of different types of schools could show the value of such work, which should probably extend until all children were assessed at least at the beginning and at suitable periods before the ending of their educational careers. The ascertainment of those who need special tuition, or are below the standards of ordinary training, as well as those needing care would be an incidental part of such work.

Still more valuable would it be to ascertain those who just fall clear of the deficiency net, but who are subnormal children, always causing trouble in their endeavour to cope with the problems beyond their limited capacity. Help and guidance at an early stage might save much social trouble, and minor criminality at a later stage. In other words, it should be possible to deal with the inadequate psychopath before habitual abnormal conduct has developed. The maladjusted child would be ascertained also at an early stage, and both child and parents saved from mental friction with the resulting nervous reactions and faulty conduct.

All this merely envisages a wider ascertainment with more emphasis on the treatment of the normal child, whose value to the community is greater.

The education and training of the defective in special schools and classes is bound to vary between centres of dense populations and sparsely populated areas. There is divergence of opinion as to the provision of centres where defectives can obtain some form of manual training, while being with their parents or guardians. Some advocate such a development, while others say that the training can only be given properly in a residential institution, where their whole habits can be adequately supervised and trained. The necessity

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for institutional care is likely to be greater where the child is far away from facilities for special instruction. While the general trend seems to be in favour of colonies having a proportion of each of the different grades of the defective population, special provision for the delinquent defective seems necessary.

The establishment of more hostels for the resocialization of the high-grade defective appears to be necessary in any properly organized health service.

The question of advice regarding the treatment of the delinquent needs consideration. To a large extent this is met by medical reports from prisons and probation officers. Adequate psychiatric advice should be available for all magistrates and judges where the mentality of the prisoner is in any way abnormal, or where persistent aberrant conduct needs attention. In the larger prisons the full-time officers usually have some psychiatric experience, but in local prisons part-time general practitioners may have no such knowledge. This type of work was developed by the late Dr. W. H. Potts when working in the Birmingham area.

Some would say that all this specialized work should be grouped separately from the rest of psychiatry, with a special deficiency or child psychiatric officer, but the problems overlap, and although specialization will tend to occur, such work will essentially be a part of any complete mental health service.

The Organization of the General Treatment of the Neuroses and Psychoses.

This involves the co-ordination between the general hospitals, special psychiatric hospitals, observation wards, and the mental hospitals.

A considerable amount of the activity at the general hospitals will be out-patient work, and this largely among the neuroses. The organization if reasonably complete will need to include arrangements for psychotherapy and social services. Although work among the neuroses can be mainly and advisedly confined to out-patients, a small proportion will definitely improve more quickly with in-patient care. The break from unsatisfactory work or home conditions may be directly beneficial. For example, in industrial cases such a break may alter faulty reaction which is becoming a habit disastrous to the patient. Generally speaking, however, work among the neurotics can be mainly confined to out-patient activity, with a small hinterland of beds for certain types of patients. Where the anxiety cases are exhibiting depression or the hysterical case some disorder of conduct the need for in-patient treatment becomes more evident. Further, the mild depressive and the early schizoid group insensibly shade off from the neurotic type and borderland type, who can be suitably treated together. Where should such treatment be given and where should the line be drawn? In practice this varies. Some would say that the wards of a general hospital should be specialized for this work. Some advocate special hospitals or early treatment centres, and some would receive these cases into the wards of a mental hospital on a voluntary basis.

The difficulties of establishing an efficient special unit in a general hospital

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are considerable, and while this is easy in a mental hospital, it is notorious that the slighter type of case is very sensitive to being classed with those who are more disturbed. Indeed, there is a distinct school of thought who believe that every endeavour should be made to separate the neurotic and psychotic, and to see that these two classes of case are treated separately. This in practice is hardly feasible, as cases change their reaction, and apparently mild neurotics may develop psychotic symptoms, and marked psychotics may exhibit good control. The essential dividing line is inevitably one of conduct. Early treatment centres should meet some of these difficulties, and allow neurotics and mild psychotics to get treatment under conditions which should satisfy both themselves and their relatives.

The problem of the more acute but equally recoverable case also needs attention. Many would emphatically say that they should enter mental hospitals. Others contend that there is a case for establishing centres where a number of such acute cases should not merely be sorted, as in the observation wards, but where they can be investigated and treated in an acute psychiatric hospital. Separate psychiatric units for the milder and also for the more acute types would only be feasible in large centres of population. In smaller towns some fusion of such activities would appear to be inevitable, and a relatively smaller number of beds should meet requirements. One to 10,000 of the population has been computed, but variations in type and mode of usage will affect any such computations, and a higher proportion will probably be needed.

The units in the university centre will, it is hoped, be considerably devoted to teaching and research, and will act as focal points for psychiatric advancement and development. Diagnosis and treatment, however, will be a definite function, and this is likely to be the main objective in the smaller units.

Such early treatment centres will provide facilities rather than seriously affect the work in the mental hospitals, as the longer continued case will still require treatment which the mental hospital can only adequately provide. How far the treatment of the early recoverable case should be completely separated from the segregation of the chronic will continue to be debated. Personally, I hold that the two functions of the mental hospital should be completely separated as regards the sites of the buildings, although attended by the same staff. This, however, represents an extreme view, unlikely to materialize, certainly in the near future.

An in-patient aspect of the mental health problem is the prevention of the silting-up of large aggregations of patients who have recovered from the acute phase of their psychoses, but continue to need care for economic or other reasons. Some will deteriorate to an extent that institutional care will be inevitable, but many might be accommodated in colonies or hostels at the termination of the acute phase of their illness. A number of small hostels of about twenty beds, intelligently organized with a view to resocialization and rehabilitation, should go far in reducing the extensive segregation at present necessary.

Social Services.

With the integration of a mental health service it should be possible to co-ordinate the psychiatric and social services into one corporate whole for

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each area. Workers at the various out-patient clinics, general and psychiatric hospitals, and also at the mental hospital, should be reasonably interchangeable, although those dealing with children are likely to remain specialized, while those dealing with defectives will have a less elaborate training.

An important question is the extent of the problem, and the requirements likely to be necessary. As regards the neuroses, the present inquiry of the Ministry of Health will show the numbers of those needing treatment under present conditions, and future conditions are hardly predictable.

The Board of Control statistics show the numbers of cases of psychoses needing care in mental hospitals. A complication is the fact that there is a steady decrease in such cases during the war, and there can be no guarantee that post-war conditions will restore the previous balance as quickly as after the last war. Indeed, if our reconstruction plans are successful, the continued lack of industrial stress may alter the whole problem. The fact remains that for a period after the war, it is likely that so far from being overcrowded, there will be vacancies in mental hospitals, so that pressure for beds will not encourage local health authorities to establish new buildings.

The problem of mental hospital accommodation will be still further reduced if all mental defectives are removed to appropriate institutions, with the establishment of further deficiency colonies.

The child psychotic is better given special accommodation. The maladjusted and early psychotic child can be suitably dealt with in special wards in the early treatment centres for mild psychotics.

The problem of the psychopath, or psychopathic personality, links up both with the defective and recidivist activities. The inadequate psychopath is often mildly defective, and is then primarily a mental health problem. The psychopath with mild psychotic and neurotic trends, at times with sexual abnormalities, also comes into the scope of mental health. Recently attention has been drawn to the aggressive psychopath, who shows cortical dysrhythmia as shown by the electroencephalogram. Certainly after adolescence such aggressive cases do not seem likely to respond to treatment, and the question as to the type and form their segregation should take needs attention.

Conclusions.

Numerous proposals have been put forward in many discussions. Inevitably some points of view are incompatible and some compromise has to be effected.

Nevertheless, in general, the majority of psychiatrists are agreed, but their views will not necessarily coincide with those who control somatic medicine and the educational services with whom it is essential they should work if successful results are to be obtained.

The following attempt to summarize some of the views likely to be put forward is necessarily tentative, and expresses a number of the widely varying aspirations of psychiatry. It is largely covered by the Memorandum of the Royal Medico-Psychological Association, which since writing the above has

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been presented to the Ministry of Health, and is now available for publication (see Addendum).

The educational work will in particular need careful and tactful adjustment. Both in this field and in that of industrial psychology, very realistic and practical advice is essential if psychological guidance is to obtain an established position.

The basal idea is a broadened concept of psychiatry, embracing preventive mental health as opposed to merely dealing with disease when it occurs. Recommendations to give effect to this include:

(1) The recommendation that the Board of Control shall be reconstituted as a Board of Mental Health.

(2) That each area which constitutes a unit of physical health shall form a committee to co-ordinate and control all aspects of mental health.

(It is realized that as some of the constituent elements of such a mental health committee will be statutory, legislation will be necessary to bring such a new body into being.)

(3) That such a committee shall appoint an expert psychiatric adviser or advisers to assist in co-ordinating such work. The relations of this officer to those dealing with somatic medicine has already been discussed and the reason for co-ordination explained. The balance of psychiatric opinion seems likely to favour a medical officer of mental health.

The constitution and form of the committee will presumably be determined on the same lines as those dealing with physical health. Unless adequate representation of all types of mental health is possible on the executive committee, it is likely that this will need to be supplemented by an advisory medical committee, with powers to make representations regarding the speciality.

Other suggestions are the formation of early treatment centres:

(*a*) In association with the medical schools, with facilities for teaching and research, either as part of the general hospital or as a specialized unit. The units should be the focal points for psychiatric development in the area.

(*b*) For acute psychoses, either as a specialized unit or one associated with the mental hospitals.

(*c*) Combinations of such units in smaller areas where separate units are hardly feasible.

(*d*) Other units for the in-patient treatment of psychoneuroses or mild psychoses.

The success of such units in meeting a public demand will determine their continuance and expansion.

Industrial psychological medicine.—A medical officer in each area should advise in regard to industrial problems, including disabilities with an obvious psychological basis. Long hours and other sources of friction should be dealt with in an expert manner before disturbance arises.

Similar advisers for delinquency problems should be provided, and independent medical assessors should be available for all courts.

All school activities should be co-ordinated. A regular psychiatric report on each child is the ideal to be aimed at. This would include ascertainment of

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the defective, and should allow every child attending school to be graded into the type of work for which they are most fitted. Advice as to those most suitable for craftsmanship or for higher education should be supplemented by data drawn from school results.

The development of social medicine in general will need psychiatric help. Given a proper organization, all this help should be available as and when required.

The proposal to establish medical committees to give the mental hospitals the advantages which such a committee provides in a general hospital has much to commend it, although much greater difficulty in finding a satisfactory composition and constitution is inevitable in any type of special hospital.

An important change in existing law has been proposed and sponsored, among others by Dr. W. G. Masefield, Secretary of the Royal Medico-Psychological Association. He suggests that all cases during the first six months of mental hospital care should be under temporary treatment, whether they are voluntary or otherwise, extension to nine or twelve months being permitted, as at present. In other words, it would permit for mental treatment, the detention of persons for six or even up to twelve months, on the application of their nearest relative, supported by the medical certificates of two doctors, one of whom must be recognized as an expert by the Board of Control. This would be a revolutionary change, but precedent exists, and it would allow all early treatment to take place without legal certification.

These proposals may appear visionary, but they represent a number likely to be put forward. They envisage great developments in psychological medicine, which will only be possible given a greatly increasing number of psychiatrists suitably trained. To be expert it is evident that all psychiatrists should have experienced all aspects of the subject, which includes the neuroses, psychoses, child psychiatry, mental deficiency, together with a knowledge of neurology. There is some hope that these needs will ultimately be reflected in the requirements for the Diplomas in Psychological Medicine. The necessity for higher specialized diplomas is already being felt, and the suggestion formulated by a group of physicians, associated with Sir Walter Langdon-Brown, that such specialization should be allowed following the possession of the original Diploma in Psychological Medicine has much to commend it.

Behind all this lies the education of the medical student, and future practitioners in psychological principles and knowledge. Unless undergraduate teaching is provided both in psychology and psychiatry, with some examination test, progress will be difficult. A proper understanding of psychology is essential for every branch of medicine, and a knowledge of psychiatry, especially as regards the neuroses, is essential for all practitioners.

Numerous references and meetings have been referred to above, and suggestions have come from many sources. A number of references will be found in the British Medical Association's Report, and many facts will be found in the Annual Reports of the Board of Control. The Reports of the Massachusetts and New York Mental Services give an idea of the co-ordination that has been effected in those areas, and also give an indication of the early treatment centres which exist there, and in other cities, such as Chicago and Toronto.

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ADDENDUM.

The Royal Medico-Psychological Association.

RECOMMENDATIONS REGARDING THE MENTAL HEALTH SERVICE.

General.

1. That Mental Health Committees be formed in each Area throughout the country as may be decided hereafter by the Government, such Committees to be responsible for all aspects of Mental Health, i.e. to take over the work of Committees of Visitors, the Committees under the Mental Deficiency Acts and the Child Guidance Clinic Services. Mental Health Committees should consist of elected and co-opted members. Close co-operation should be maintained between these Committees and the Public Health and Education Committees.

2. That a Medical Advisory Committee fully representative of those practising Psychiatry should be set up in each Area.

3. That large areas are preferable to small areas. Each area should be of sufficient size to warrant the setting up of a complete Mental Health Service.

4. That all matters appertaining to Mental Health Administration should be removed from Public Assistance.

5. That the present name of the Board of Control be changed to "The Board of Mental Health." The powers of the Board of Mental Health should be extended to enable it to supervise and direct all branches of Mental Health in its widest aspects, many of which are at present administered by other departments. That there should be a larger body of medical representation on the Board of Mental Health.

6. That a Medical Officer of Mental Health should be appointed in each area. He should be a principal officer with clinical and administrative psychiatric experience. His task should be the co-ordination of all branches of Mental Health. He should have equal status to that of the Medical Officer of Health, with whom he should work in close collaboration. He should be appointed by the main Mental Health Committee after consultation with and with the approval of the Board of Mental Health. His security of tenure should be similar to that of a Medical Officer of Health.

7. That a Medical Superintendent should be in charge of each Mental Hospital and Mental Deficiency Institution. He should have complete control and should be in continual touch with the clinical aspects of the Hospital and its patients. Any arrangements of Staff by which dual authority tends to be established in the central government of either type of institution is emphatically opposed.

8. That in each Psychiatric Hospital and Institution it is desirable that a Medical Board should be set up, of which the Medical Superintendent should be the Chairman. This Board should comprise all the Medical Officers with suitable experience and representatives of the Consulting Staff.

9. That it is essential for the proper understanding of all cases, including those of Somatic Disease, for Medical Students to be taught a suitable Psychology in the Intermediate stage as well as the principles of Psychological Medicine in the Final Course. At least one question on Psychological Medicine should be asked in the General Medicine Examination. Teaching and Examining Bodies should be urged to raise the standard in clinical experience of Psychiatry to the level of the kindred subjects of Medicine, Surgery, Obstetrics and Gynaecology.

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10. That there should be a unified system of Social Service. All Psychiatric Social Workers should receive such training as will fit them for service in all branches of the Specialty.

11. That Lay Psychologists should be employed more extensively and greater opportunities for their clinical training should be provided.

12. That no Mental Hospital or Mental Deficiency Institution should be set aside solely for Chronic Psychotic cases and/or Low-Grade Defectives except possibly for Senile mental persons.

Psychoses and Psychoneuroses.

13. That dependent on the area and density of the population to be served Mental Health Services should be supplied by means of the Mental Hospital and Psychiatric Units—that part of a General Hospital which is set aside for the treatment of Mental Disorders, whether In- or Out-Patient Department, should be known as a Psychiatric Unit.

14. That a number of beds, approximately 6 per cent. of total bed accommodation, should be available in each General Hospital where an Out-Patient Clinic is held regularly, provided that the Hospital has an adequate Staff of Mental Nurses trained and in training.

15. That in larger centres (especially University towns) special Psychiatric Units will, it is hoped, be established, with facilities for both Qut-Patient and In-Patient treatment, Teaching and Research.

16. That the Mental Hospital must be the Main Unit for the provision of In-Patient Services and must be maintained at the maximum efficiency in Staff and Equipment. Both the Medical and Nursing Staffs should be increased by at least 50 per cent. over pre-war standards. All the members of the appointed Medical Staff should take some part in extra-mural duties, e.g. Out-Patient, Convalescent (Rehabilitation) Homes and in a Consultative capacity at Health Centres. There should be posts for Clinical Assistants at all Mental Hospitals. These should be taken up after the usual House Officer appointments have been held in a General Hospital. Before a post on the Medical Staff of a Mental Hospital is obtained it is desirable that a Medical Officer should have experience in General Practice.

17. That Registered Hospitals and, in Scotland, the Royal Asylums should continue to carry out their present functions, but if it becomes clear that some alteration is necessary, consideration should be given, in consultation with their Governing Bodies, to the utilization of some such Hospitals for Post-Graduate study and special lines of Research, possibly in association with Medical Schools.

18. That Licensed Houses will continue to serve a definite purpose in providing beds for " Private " patients, and that therefore such accommodation must be fitted into the scheme for a Comprehensive Medical Service.

19. That amendment of the Mental Treatment Act (1930) is urged so that under Section 5 all Non-Voluntary first-admissions may be received for the purpose of treatment and detained for a period not exceeding six months, with possible extension by the Board of Mental Health, without a Reception Qrder. This involves the omission of all reference to " willing or unwilling to receive such treatment."

20. That the treatment in a Mental Hospital and its Ancillary Services and Units of all forms of Neuroses and Psychoses should be generally recognized, there being no fundamental scientific difference between the Psychoneuroses and Psychoses. The distinction for practical purposes is to be found in the degree of disorder and in changes of conduct and sensitivities of patients. That wherever a patient be treated the treatment should be provided by the associated Staffs of a Psychiatric Hospital or Unit or other recognized Psychiatric Consultants.

21. That special legislation and accommodation is required so that Drug and Alcoholic addicts may be detained under some form of Order for periods sufficient to permit adequate treatment.

Mental Subnormality, including Mental Deficiency.

22. That the problem of Mental Subnormality and its social consequences is undoubtedly a far wider one than has been generally recognized.

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23. That the present Legal and Administrative procedures need revision:

(*a*) To remove the existing confusion and anomalies whereby Defective Children are dealt with in several different ways under four different Authorities.

(*b*) To remove the difficulties of bringing under suitable care and training Children who are first seen between the ages of 14 and 16.

(*c*) To enable any Subnormal Child to receive without strict formality or Legal Certification such Special Education as may be necessary.

(*d*) To provide for the whole group of the Subnormal rather than for the restricted portion who are Certifiably Defective.

(*e*) To provide that a Certified Institution may, when advisable, admit patients on a "Voluntary" basis on the application of a Relative and one Medical Recommendation as in Section 1 of the Mental Treatment Act, 1930, and also in conformity with Section 5 of this Act on a Temporary basis.

24. That the Medical Officer of Mental Health if not sufficiently experienced in Mental Subnormality should be advised by a recognized Specialist in this field.

25. That the entire Service of the Subnormal should be transferred from the Public Assistance Authorities to the Mental Health Committee.

26. That for the Retarded Group an increased number of Special Schools, both Residential and Day, are required. More Occupation Centres should also be established.

27. That Residential School treatment under Psychiatric direction should be made available for Maladjusted Children, preferably by Voluntary admission.

28. That Approved Schools at present under the Home Office should be directed by the Board of Mental Health.

29. That community care of the Retarded Class and Licence from Institutions should be widely extended. All large Institutions should have several Branches, both for use as Hostels and for Training and Rehabilitation.

30. That in each area there should be provision for a period of Observation by Temporary Residence in a Special Unit or in an existing Institution before Certification as a High-Grade Defective. Admission to such Units should be on a "Voluntary" basis in the case of Minors or on the Order of a Magistrate or other Official approved for the purpose by the Board of Mental Health, and should not be for a period exceeding six months. That no Medical Practitioner without special experience and qualification should be empowered to certify Mental Deficiency.

31. That all Medical Officers employed in Mental Deficiency Colonies or Institutions should have opportunities for extra-mural duties in order to maintain and increase their interest and to provide the essential Specialist advice in Schools, Clinics and Hospitals.

32. That Medical Officers working in the field of Mental Subnormality should maintain close co-operation with the School Medical Officers so that consultations may take place in regard to educability and ascertainment.

Child Psychiatry.

33. That the Child Psychiatry Service is an integral part of a Mental Health Service. Child Guidance Clinics with associated In-Patient facilities are required in every area, and should be under the management of the Mental Health Committee working in close co-operation with the Education Authorities.

34. That as an important prophylactic measure there should be systematic Psychological Examinations of each School Child. These Examinations should be primarily the province of the Educational Psychologist, selected cases being referred for full Psychiatric examination as required.

35. That all Delinquent Children should be examined by a Psychiatrist, whose report should be available to the Court.

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GENETICS IN PSYCHIATRY.

By ELIOT T. O. SLATER, M.D., M.R.C.P., D.P.M.,
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GENERAL GENETICS.

WORKERS in psychiatric genetics are, with some notable exceptions, psychiatrists first and geneticists second. Neither their medical nor their psychiatric training equips them with an appreciation of scientific method, and their narrow specialization prevents them from keeping abreast of advances in the general field of animal genetics. As things are, this is an important source of weakness; for the general geneticist, whose science is in a much more advanced state, has accumulated facts and theories that have an immediate application in our special field. One has therefore to notice comprehensive reviews of the present position in genetics in relation to the theory of evolution which have recently been provided by Dobzhansky (1941) and Huxley (1942). In what follows the work of Huxley has chiefly been drawn upon, and it is intended to provide a brief summary of the most important of these ideas.

Huxley criticizes medical genetics for the tendency shown there to relate qualities in an absolute fashion to unit genes. "Actually, every character is dependent on a very large number (possibly all) of the genes in the hereditary constitution; but some of these genes exert marked differential effects on the visible appearance. Both rose- and single-comb fowls contain all the genes needed to build up a full-sized comb; but 'rose' build it up according to one growth-pattern, 'single' genes according to another. . . . Medical men have usually been obsessed with the implication of 'character-inheritance.' When the character has not appeared in orthodox and classical Mendelian fashion, they have tended to dismiss it with some such phrase as 'inheritance irregular,' whereas further analysis might have shown a perfectly normal *inheritance* of the gene concerned, but an irregular *expression* of the character, dependent on the genes with which it was associated and upon differences in environment. . . . To-day the notion of Mendelian characters has been entirely dropped."

Genes are thought of nowadays as exerting their influence by biochemical means and being concerned principally with the rates of processes. They themselves are subject to the same sort of influence. Timakov has detected in wild *Drosophila* a gene increasing mutation rates at least forty times, possibly to a higher level than that induced by X-rays. A gene may have a direct effect on two or more distinct processes and thereby on quite different characters, e.g. the white-eye allelomorphs in *Drosophila* also affect the shape of the spermatheca. A gene may affect a single process, but in many sites and conditions,

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e.g. Bonnevie's mouse gene which causes the exudation of blebs of fluid at a particular stage in embryonic development; this causes widespread and phenotypically very different abnormalities, depending on the exact stage in development when the gene begins to exert its effect. A gene may produce a primary direct effect, and this in turn secondary effects. For instance, Grüneberg's rat gene causes hyperplasia of cartilage. The secondary effects of this are emphysema, hypertrophy of the right ventricle, blocked nostrils, incompletely occluded incisor teeth. Environment may mask or bring out the results of genetic differences: "vestigial" *Drosophila*, for instance, when grown under dry conditions, develops normally. The gene must be distinguished from its mode of expression. The gene is only altered by mutation, but its expression is the result of a balance between a very large number of factors, both genotypic and peristatic.

Large numbers of gene differences are extremely small, down to the limit of detectability. Multiple allelomorphs are very common, and up to a dozen or more are known for single loci. The differences between the effects of these are quantitative and may be very slight. It is probable that these genes of small effect are the main sources of the building blocks of evolution. They must be looked for wherever there is a continuous range of normal variability—for instance in psychiatry in the analysis of mental defect, temperamental instability, etc. Even genes of the classical type, which produce a gross qualitative change, will be subject in their expression to the influence of these genes of small effect, which are here called modifiers. The influence of these genes may be expected to show itself in, for instance, determining the age of onset of schizophrenia, and in causing differences in the clinical picture when schizophrenia is exhibited in a pyknic or a leptosome habitus. (Evolution has probably proceeded by accumulating modifiers to damp down the undesirable effects of genes whose main effects are advantageous.)

The distribution of genes within a given population is an important subject of research. The very large numbers of recessive genes which are carried in heterozygotic form by most animal populations are an important source of variability, without which evolution could not occur. The larger the size of the interbreeding population, the greater the potential genetic variability. In small populations the Sewall Wright phenomenon of drift can be observed, i.e. the chance accumulation or extinction of mutations, with resulting decrease in variability. Large populations can carry slightly deleterious mutations with reasonable frequency, especially when recessive, having thereby a reservoir of potential evolutionary change. For if such a recessive gene has an advantageous effect under changed circumstances, the accumulation of modifiers will with time suppress its deleterious qualities, and even shift its effect from recessivity towards dominance.

The importance of these notions for an understanding of the problems of psychiatric genetics will become abundantly clear in the following pages.

The Theory of Psychiatric Genetics.

Penrose (1942*a*) points out that the effect of natural selection is rapidly to eliminate harmful dominant mutations which produce their effect before or in

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the reproductive period. They can be kept going only by a considerable rate of fresh mutation (e.g. epiloia). Recessive conditions, and dominant ones which produce their disadvantageous effect after the reproductive period, are less susceptible. The accumulation of modifiers will tend to postpone the manifestation of dominant mutations till later in life, and as the reproductive period is longer in the male than in the female, the degree of postponement will tend to be greater in the male. Penrose quotes evidence to show that this is so in the case of Huntington's chorea and manic-depressive psychoses. Penrose suggests also that the disease is more frequently recognized in females, and may run a milder course in males. It is, however, difficult to see, if this is the case, how it could be an effect of natural selection. Penrose develops the argument to show that in the case of recessive conditions the converse should be true, and gives some evidence that in the case of schizophrenia and mental defect it actually holds. Again, however, it is not made clear why this effect should be an expected one. Either the reviewer has not rightly understood the argument, or a *non sequitur* has been allowed to creep in. The basic notion is that dominant abnormalities are exposed to the action of natural selection, whereas recessive conditions are relatively sheltered. From this it follows that certain differences between the sexes may be expected in the case of dominant conditions, which will probably not be seen in recessive ones, but not that the latter will show the converse of the phenomena observed in the former.

Penrose (1942*b*) has made another interesting contribution to general theory. It has been observed that when two relatives are both affected by some form of mental disorder, the relationship is more often between two males or two females than between a male and a female. From the publications of Mott and Myerson and his own material Penrose collects data about 2,363 such relationships, and finds a correlation coefficient of approximately + 0·11, which is certainly significant. He attempts to explain these findings by the following hypothesis. Sex is determined not only by the XY chromosomes, but also by the autosomes. Sexual differentiation is not simply into male and female, but is a bimodal distribution showing overlapping. American psychological test results have shown that some females are more male mentally than are some males. A gene which tends to produce masculinity will not produce noticeable effects in a person already constitutionally male, but will have an observable effect in the female. The converse will be true of genes predisposing to femininity in the male sex. These genes occurring in families will therefore tend to show a male-male and a female-female type of coupling. If any of them also predispose to mental disorders, these mental disorders will also tend to show the same type of coupling in family histories. The argument does not seem to be sound. Given that a gene causing a feminine attitude of mind in the male will tend to show a male-male type of coupling in family histories, it does not follow that any associated effects in producing mental disorder will show the same type of coupling. Only if the hypothetical feminine gene tended to upset the balance of the male mind and not that of the female would such an effect be observed, and there is no reason for believing this to be so. Alternatively it would be necessary for these accessory sex genes,

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hypothetically also capable of producing mental disorder, to have at times the effect of actually altering the manifest sex of the individual. A simpler explanation of Penrose's interesting finding would be as follows: We know that the manifestation rate and the form of expression of genes are influenced by a great number of other factors than the gene itself, genetic, biochemical, and more strictly environmental. It is then only necessary to suppose that some of these factors are more likely to be the same for persons of the same sex than for persons of opposite sex.

Interesting work, fundamentally concerned with the same idea, has been done by Lang (1939) on male homosexuals. Arguing that imbalance between the sex chromosomes and the autosomes can, as has been demonstrated by Goldschmidt in *Lymantria*, produce reversal of the manifest sex in man, and that persons of reversed sex are more likely to be found among homosexuals than among normal individuals, he calculates that if one were to examine the sex distribution in the sibs of male homosexuals one would expect to find an excess of males. With the co-operation of police officials, he was able to obtain data about the sex of the sibs, living and dead, of 1,517 male homosexuals. These consisted of 2,534 males and 2,034 females, being 124·6 males to 100 females, a ratio that differs from the normal expectation of 105 : 100 by a margin that is highly significant statistically. A control investigation of the sibs of a solely male group of propositi of comparable size showed no such shift. Taking only the older homosexuals, who might be expected to be a more highly constitutional type, the male shift of the ratio was still more marked. Data are also provided about the half-sibs, and twins, also significant. Lang suggests that there may be, apart from the possible genetic basis, a hormonal interference in utero, as occurs with the free-martin. He points out that further research is needed, and suggests particularly the investigation of female homosexuals and of the frequencies of colour-blindness in both types of homosexual.

An observation of minor theoretical interest has been made by Idelberger (1939). According to him, the incidence of club-foot, wherever reported, is always 2 males to 1 female. This would be inexplicable by any normal form of Mendelian inheritance, and he suggests that manifestation is controlled by sex-linked modifiers.

Population Problems.

The frequency and distribution of genetic differences in human communities have been discussed by Dahlberg (1941). He particularly directs his attention to disturbance of amphimixis, or randomness of marriage and fertility, by the isolate effect. The general population is made up of a number of isolates or inbreeding communities. The limits of these, which are seldom sharply defined, are of geographical, social, occupational, religious and other kinds. The smaller the isolate, the more frequent is homozygosity. Isolate boundaries are now breaking up. The frequency of cousin marriage decreased in Bavaria from 0·87 per cent. in 1876–80 to 0·20 per cent. in 1926–33. This would suggest that the size of isolates is on the average double, perhaps treble that of fifty years ago. There should be a corresponding decrease in the incidence of recessive abnormalities, e.g. idiocy, impossible to measure in fact owing

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to poor registration. One should also observe the wider manifestation of the effects of dominant genes, perhaps indicated by an increase of 9 cm. in the average stature in Sweden in the past 100 years. Dahlberg also considers the effects of selection, particularly on recessive conditions. Once the frequency of recessive conditions has reached a lowest limiting level, selection against the homozygote will be ineffective in reducing the frequency of the gene. Dahlberg hopes that rare qualities, such as the capacity for independent thinking, may prove to be dependent on recessive genes; for then they would be inextinguishable, no matter how ruthless the effort to exterminate such individuals.

Further theoretical mathematical work on the statistical methods to be employed in the investigation of inbreeding have been carried out by Haldane and Moshinsky (1939). The authors have specially dealt with cousin marriage. Such basic theoretical work is very necessary for the effective application of practical research. It would be most desirable that comparable work should be done on the mathematics of assortative mating, as is shown by the inadequacies of Koller's work, to be discussed later.

Osborn (1939) has examined the fertility of graduates of Princeton University with samples taken over 30 years. The group has a low fertility, below replacement rate, but it increased slightly over the 30 years. Within the group there was some association between success, both at college and later, and fertility. A parallel investigation of the association of fertility with intelligence has been carried out with care on a large group by Fraser Roberts (1939). A sample of 3,400 children was submitted to intelligence tests. The association between intelligence and number of living sibs provided a correlation coefficient of — 0·224. Intelligence fell off evenly and steadily as the number of sibs increased, and vice versa. This has confirmed similar findings in the U.S.A. A more detailed examination of the highest 4 per cent., median 4 per cent., and lowest 8 per cent., rated by intelligence, showed that the more intelligent families were complete, whereas a large proportion of the families of lowest intelligence were incomplete. The correlation coefficient is therefore an underestimate. Roberts also showed that intelligent people of the lowest social class were just as infertile as persons of comparable intelligence in higher classes. The restricted fertility of the intelligent is, presumably, deliberate, though Roberts does not say so.

Brugger (1939*b*) has examined the debated topic of the relation between migration and intelligence. It is often asserted that in rural populations the more intelligent tend to migrate to towns and places of greater opportunity. In Switzerland Brugger obtained, by a follow-up of 1,700 rural ex-school-children of the years 1895 to 1920, no evidence of any preferential migration of this kind. He points out, however, that Switzerland is in a rather special position, as the opportunities and facilities of country life differed little from those of towns. There were also no observable differences when emigration abroad or overseas was considered.

Grobig (1939*a*, *b*) has investigated the frequency of the more important psychiatric abnormalities in the children, sibs, nephews, and nieces of a superior population group (works foremen and their wives), and has found their incidence to be below average expectations.

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Literature, Reviews, Etc.

General reviews of recent advances and modern theories have been provided by Bleuler (1939), Brugger (1939), Hurst (1940), Kallmann (1941*b*), and Stumpfl (1939*a*). Bleuler deals with the endogenous psychoses and epilepsy, Brugger with mental defect, Stumpfl with psychopathic personality. The greater part of Hurst's article is concerned with Kallmann's work on the genetics of schizophrenia; he particularly discusses Kallmann's theory that the anatomical substratum of the predisposition to schizophrenia is an inherited weakness of the reticulo-endothelial system. Kallmann's review is intended for a non-specialist medical audience. He emphasizes his view that schizophrenia and manic-depressive syndromes must be considered distinct clinical entities based on independent and specific autosomal hereditary factors. With a strict psychiatric definition of the two conditions they are not found to occur together in the same families.

Discussions of points of general or particular research interest have been provided by Conrad (1939), Davidenkov (1940), Essen-Möller (1940), Panse (1939), Schulz (1939*a*), Slater (1939). The papers by Schulz and Slater are concerned with the statistical technique of twin investigation. Conrad emphasizes the quantitative aspects of gene activity, and attempts to familiarize the psychiatrist with other current genetic concepts. Davidenkov's paper is of more neurological than psychiatric interest. He discusses the problems raised by the observation that clinically identical conditions may follow different modes of inheritance in different families, or may show different degrees of penetrance in different families or in the same family in different generations. He deals with the problems of gene interaction, of minor anomalies and organ inferiorities in the families of persons showing an inheritable disease chiefly incident on those organs (e.g. the frequency of pes cavus in the families of subjects of Friedreich's ataxia), etc. Essen-Möller, in a discussion designed for a general medical audience, relates modern genetic theory to empirical advances in psychiatric genetics. He discusses the importance of the time of incidence, in the course of the individual's development, of the effects of a mutant gene, and suggests that the association of an asthenic physique with early onset, and of an athletic or pyknic physique with a late onset of schizophrenia, may be due to the biological effects of the schizophrenic gene itself. Panse pursues somewhat similar notions, and emphasizes the importance of distinguishing the abnormal gene from its phenotypic effects. The purpose of genetic research is rather to discover what is inherited than to force observed familial differences into a theoretical scheme.

Meggendorfer (1939) has reviewed the subject of alcoholic blastophthoria. It is well known that the application of X-rays or of any polarizing ray above 3022Å will increase mutation rate in the germ cells; and there is evidence that the same effect can be produced by other agents, including chemical ones. Forel suggested many years ago that the germ cells of the alcoholic might be damaged in this way. Blum observed such an effect in mice, but the abnormalities caused did not persist into the second generation. Family investigations in man have given equivocal results. Panse found no difference in the children

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of alcoholics born before and after the time the addiction of the parent began. Meggendorfer concludes that some effect of alcoholic addiction on the mutation rate is probable. Jahnel (1939), on the other hand, concludes, after a discussion of the relevant literature, that syphilis has no such effect.

Mental Defect.

The genetics of mental defect have been greatly clarified, largely as the result of work in England and America. Research workers of outstanding ability in Germany and Switzerland are still puzzling themselves with out-of-date problems, as a result of their neglect of the accurate quantitative methods of measuring intelligence now available. The highly developed tests of intelligence that we use here and in the U.S.A. seem to be unknown on the Continent. Our present knowledge of the genetics of mental defect has been excellently summarized by Fraser Roberts (1941*b*). The intelligence of the normal and healthy human individual is determined by a very large number of genes of small quantitative effect. Where many genes of positive effect are present intelligence will be high; where the majority are of negative effect intelligence will be low. The frequencies of persons of high, average, and low intelligence in the general population are such as is required by this theory, i.e. they form a curve of normal distribution. In this respect intelligence is comparable with stature. There are, however, too many persons of low intelligence (as of low stature) to be accounted for by normal variation. A rough dividing line can be drawn between the normal and the morbid, at about I.Q. 45. Feeble-minded persons are to be considered abnormal only against the background of our society. The frequency of mental dwarfs is not high, being in school-children about 4 per 1,000. Rare specific genes, productive of very low grades of mental defect, must be very numerous; for gross mental deficiency means only a grossly impaired central nervous system, which may be caused in a great variety of ways. The specific forms now sifted out—phenyl-ketonuria, amaurotic idiocy, etc.—together do not account for 1 per cent. of low-grade deficiency. Most of these genes produce other effects than on the central nervous system; and conversely genes known for other effects, e.g. that of albinism, also produce changes in the C.N.S. in a proportion of cases.

Fraser Roberts (1940, 1941*a*) has supported this general theory with confirmatory evidence. A sample of 608 children taken from a larger group gave a sib-sib correlation in point of intelligence measurements of + 0·535. He concludes that the correlation coefficient must be taken to exceed + 0·5 (the amount demanded by the multifactorial theory) by an amount which is probably provided by a significant correlation between the intelligence of the two parents. It would be very desirable to have an actual measurement of this correlation, and further evidence of value could be obtained from the correlations provided by intelligence measurements in other degrees of relatives. Nevertheless the evidence already obtained is such as to make it practically certain that the multifactorial theory is correct.

This being so, one cannot give the attention it would otherwise deserve to

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the painstaking and thorough work of Brugger (1940, 1941) and Juda (1939*a*, *b*, *c*). Brugger supports the genetic uniformity of clinically uncomplicated mental defect, and provides evidence for this by collating his own family investigations with those of other Continental workers, to give tables of frequencies of different degrees of defect among the various relatives of defectives of different grades. Regarded with insight, his tables, arranged purely qualitatively, show the clearest indications of quantitative relationships. Juda (1939*a*, *c*) has investigated 392 twin pairs from 485 twin births found in 18,183 ex-special school-children. Endogenous types of defect showed 100 per cent. concordance in the uniovular pairs. The frequency of twinning, 2·86 per cent., is the highest yet recorded in any family investigation, exceeding the high frequency found by Conrad in epileptics. Binovular twins were markedly in excess. Juda interprets this as a chance result, but the figures are significant. Prematurity and birth anomalies were more than averagely frequent. She discusses the exogenous causes of defect in detail, parental occupation and fertility, the frequency of illegitimacy, of socially inferior homes, of psychopathy and psychosis in the propositi. The frequency of schizophrenia was not raised, but that of epilepsy was. She supports Smith's view that the majority of cases of defect with neurological abnormalities are also of genetic causation. The very rich and important twin material is presented in summarized form case by case. In another paper (1939*b*) Juda considers the genetics of the mildest degrees of defect, and concludes that these cases are only in part of genetic causation. Without quantitative measurement it is impossible to be certain of the very slightest degrees of defect, and this work is of little value.

Damon (1941) has investigated the physical correlates of mental defect. His work, which is done with great care and thoroughness, both anthropometrically and statistically, shows that morons differ significantly from normals in a number of bodily measurements, and show in general greater variability, smaller size, relative preponderance of linear development, low sloping forehead, prognathism, receding chin, narrow temporals, marked asymmetry, thick lips, weak hair development. Dayton and Truden (1940) present statistical data on maternal age at birth of normal and defective behaviour problem children in 23,422 families. They find in the sub-average, but especially in the imbeciles, an excessive representation of the 35–49 age-group, which is statistically assured. An interesting note on geographical differences in the inheritance of defect is reported provisionally by Langner (1939). In Upper Silesia he found in the families of defectives a lower incidence of defect and an excess of male defectives, whereas in Lower Silesia the sexes were evenly represented. The two populations differ in other psychiatric and biological properties. Langner suggests that sex-linked factors are present in Upper Silesia which are lacking in Lower Silesia. Criticism must await a larger material and more detailed accounts than are presented in this summarized paper.

Other contributions to the study of ordinary forms of mental defect are of less importance. The work of Berry (1939) is of greater importance to eugenics than to genetics. Duff and Dinger (1941) found non-significant differences in

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the incidence of consanguinity between certain clinical groups. Keiser and Halperin (1939) give a preliminary account of a sib investigation in which the data are dealt with by the new technique of analysis of variance. Hopwood, Kirk and Keiser (1941) report some hard work done for nothing, their data being presented in a way which is useless for comparison. Hecker (1939) suggests that idiots in whom destructiveness is a marked trait are more likely to show exogenous causation. Hell (1939*a*) finds, from an examination of 174 defective and control twin pairs, that late development of walking, speech and sphincter control are more characteristic of exogenous than endogenous defect. In another study (1939*b*), she finds no great differences between normal and defective twins in frequency of prematurity, birth anomalies, etc. On this issue the work of Juda is probably to be preferred. Mäurer (1939) reports a large number of air encephalograms, and finds them useful in distinguishing between endogenous and exogenous defect. Southwick (1939) followed up 488 children of institutionalized defectives, and found that their intelligence values could be fitted to a normal curve with mode at I.Q. 60–69 above that of their institutionalized parents (I.Q. 55)—an expected regression towards the norm. His findings support the multifactorial theory. Wardell (1941) gives a valueless account of a family of defectives extending into six generations and 300 members. Penrose (1939*a*) has given a useful table of expectations of defect when the mental grade of a parent or sib is known, and (1939*b*) has discussed in a stimulating way existing and possible future lines of research into the genetics of defect.

A number of reports are to hand on specific forms of defect. Jervis (1939) describes in full 125 families containing 200 cases of phenylpyruvic oligophrenia—a very large collection of a very rare syndrome. The statistical analysis is exhaustive, sufficiently so to provide a useful exercise book on statistical methods in psychiatry. Simple recessive inheritance is proven. No association with other abnormalities is found. Schröder (1939*a*) has reported on 49 mongol sibships. Ross, Hawke and Brown (1941) report four cases of gargoylism in two sibships. Halperin and Curtis (1942*b*) report one case, the only abnormal in a sibship of three; they discuss families previously reported, and conclude that the inheritance of gargoylism is simple recessive. Jervis, Roizin and English (1942) describe the clinical and pathological findings in a case of juvenile amaurotic idiocy. Jervis (1941) has also described six cases in a sibship of fifteen; he discusses the inheritance, which Sjögren has found to be of simple recessive type. Whitnall and Norman (1940) report in detail a case of microphthalmia; the family history, previously reported by Fraser Roberts, showed sex-linked inheritance through four generations and 14 patients. Kallmann, Barrera and Metzger (1940) also report a sibship containing four cases of microphthalmia, two of them being the first pair of uniovular twins reported. Inheritance here was of the simple recessive type. Oliver (1940) has reported an unusual family showing recessive polydactyly associated with mental defect. Polydactyly is usually dominant, and not so associated. Halperin and Curtis (1942*a*) report a case of anhidrotic ectodermal dysplasia associated with mental deficiency. Most reported cases have shown sex-linked recessive inheritance, and the association with mental defect has not

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been previously noted. In this family inheritance was of the usual type. The authors suggest that the ectodermal dysplasia in their case had affected also the development of the nervous system, and that the defect was thereby a direct result of the syndrome. It might, however, quite easily be merely coincidental. Illing (1939) has reported seven cases of tuberose sclerosis, two of whom were sibs. The incidence of epilepsy, mental defect, minor skin abnormalities, etc., in the families are discussed. In his discussion of the genetics of this disease the author shows himself ignorant of Penrose's work. Ferriman (1941) has discussed the genetics of oxycephaly and acrocephalo-syndactyly; he concludes that inheritance is dominant, and that the association of syndactyly with oxycephaly is either due to the action of modifying genes or to the genes responsible being allelomorphs. Thums (1939) has gathered the large number of 90 pairs of twins, one or more of whom showed Little's disease. Of the 13 uniovular pairs 1 was concordant, 3 partially concordant, 9 discordant. Of the 33 binovular pairs, 2 were concordant and 2 partially concordant. He concludes that other factors than heredity must play a decisive role.

SCHIZOPHRENIA.

Probably the most important contribution to the genetics of schizophrenia is a statistical paper by Koller (1939). He makes use of the large family material provided by the researches of Kallmann. The finding which proves of most critical importance is Kallmann's observation that the incidence of schizophrenia is greater in the children of schizophrenics than in their sibs. This proves difficult to reconcile with any ordinary mode of inheritance, particularly with recessive inheritance. No adequate account or criticism of Koller's paper can be given here. His method consists in taking one or two of the empirically observed frequencies as given, and on the basis of various theories of inheritance predicting further rates of incidence, which are then checked against observation. The method is far from rigid and lacks elegance. Nevertheless, it is shown fairly convincingly that on the theory of recessive inheritance it is impossible to explain Kallmann's findings without a quite unlikely intensity of in-breeding among schizophrenic gene carriers, which is negatived by Leistenschneider's investigation into the consorts of schizophrenics. A theory of simple dominance with only a slight degree of assortative mating and with a plausible value for the manifestation rate fits empirical findings fairly well. Essen-Möller (1940) also supports the theory of dominance. He mentions, however, a suggestion of Strömgren's that the ratio of incidence in children to incidence in sibs, which is so inconveniently high for the theory of recessivity, might be explained by a higher manifestation rate in the children. The argument is not given in detail, and there is no reference to the original. Further recent support to the theory of dominance has been provided by the statistical demonstration by Schulz that at least 60–66 per cent. of all schizophrenic matings must be regarded as potentially productive of schizophrenic children.

Kallmann himself supports the theory of recessivity, and Kallmann and Barrera (1942) have recently restated it, unfortunately without mention of the

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work referred to above. They postulate a wide variation in the expressivity of the schizophrenic gene, which is subject to modification by a number of accessory genes, quantitative in their action. They have interesting remarks to make on schizophrenic twins, of which they have now collected 400. A brief account of the same material has also been given by Kallmann (1941*a*). Of the dizygotic twins, 12·5 per cent. are schizophrenic, 14·4 per cent. schizoid personalities. Of the monozygotic twins 81·7 per cent. are schizophrenic, 10·5 per cent. schizoid personalities. They are analysing these twins by Sheldon's technique, which provides indices of the relative preponderance of asthenic, athletic and pyknic components of bodily habitus. Analysis of 412 schizophrenic non-twins, for which the figures are given, shows a negative association of the athletic component and a positive association of the asthenic component with degree of deterioration.

Contributions of importance to theory have also been made by Elsässer and Schulz in provisional form. Elsässer (1939) examined the children of matings in which both parents were psychotic. The frequency of psychosis in the children was: In 10 schizophrenia × schizophrenia matings, 50 per cent.; in 2 manic-depressive × manic-depressive matings, 65 per cent.; in 6 schizophrenia × manic-depressive matings, 40 per cent.; in 10 atypical matings, 47 per cent. The author concludes that atypical autochthonous psychoses are to be regarded as endogenous. Schulz (1939) presents briefly the findings in 386 sibships where there was psychotic tainting on both sides. Where both parents were schizophrenic, the frequency of schizophrenia in the children was 31 per cent., manic-depressive psychosis, 10 per cent.; where one was schizophrenic, the other manic-depressive, corresponding percentages were 14 and 16, and where both were manic-depressive, 15 and 20. Schulz also presents other tables, e.g. where one parent was psychotic, the other having a psychotic sib, etc. The results, though very interesting, are based on too small absolute numbers for any very definite conclusions to be drawn. Schulz considers that they indicate that endogenous psychoses depend on dominant factors. For instance, where both parents themselves non-psychotic had psychotic sibs, one would expect on the theory of recessivity a much higher frequency of psychosis than among the ordinary nephews and nieces of persons suffering from endogenous psychoses. Instead, the frequencies are much the same. Schulz thinks that pure and simple dominance is as readily excluded as simple recessivity; for if simple dominance held one would not expect an incidence of schizophrenia in the children of two schizophrenics to be more than half as great again as in the children of one schizophrenic, whereas it seems to be twice or three times as great. This may be admitted; but when the influence of the genotypic milieu has to be taken into account, the theory of a single specific dominant gene remains a possibility. In a further treatment of the same subject, not accessible to the reviewer, Schulz (1940) concludes that the results of matings between schizophrenics and manic-depressives support the possibility that there is a genetic factor common to both.

A valuable collection of 92 schizophrenic sibs contained in 38 sibships has been reported by Zehnder. The detail in which the cases are presented is

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particularly welcome, as further research on the published material will be possible. She has found many different types of end-state in the same sibship, and concludes that heredity determines only the presence or absence of schizophrenia, but not its picture and course. A more adequate statistical examination, which the size and comprehensiveness of her material would make well worth while, would probably not confirm this view.

Other contributions to the genetics of schizophrenia are of minor interest. Wespi (1941) has described in great detail a pair of schizophrenic uniovular twins, and relates differences in clinical picture to slight differences in temperament. Rainey and Carson (1941) have described without comment a family showing paranoid schizophrenic psychoses through three generations. Meyer (1942) has reported a family of 59 individuals extending over four generations, in which both mirror movements, with a dominant type of inheritance, and schizophrenia occurred. There was no sign of any connection between the two conditions. Kant (1942) has investigated the family histories of 100 schizophrenics, of whom 50 made good recoveries, confirmed after four years, and 50 who deteriorated. The investigation was interestingly designed but inadequately carried out, the principal objection being that the table provided is in the form of "number of patients with familial abnormality." The material was worth a more extended analysis giving the incidence of abnormalities in the relatives arranged in age-groups. Kant observes a higher incidence of familial tainting in the recovered than in the deteriorated group, the bulk of the tainting in the former being manic-depressive, in the latter schizophrenic. One suspects a Meyerian looseness of diagnosis. If reliable, the finding would support the ideas of Schulz, mentioned above.

Kallmann, Barrera, Hoch and Kelly (1941) have examined the possible connection of schizophrenia and mental defect, with the aid of a large series of schizophrenic twins. It is impossible to do justice to this interesting paper in the space available. In 365 pairs of schizophrenic or mentally defective twins, no single pair could be found where one member was schizophrenic only, the other mentally defective only. The relations throughout were such as one would expect if the association were purely accidental.

Harrasser (1939*a*, *b*) has provided some information about racial types in schizophrenia, with correlations between race, physical constitution, and form of illness. The figures are in the form of percentages, and neither the methods by which they are obtained nor the criteria on which racial and constitutional types are differentiated are made clear. Investigations of race are more likely to be profitable in the U.S.A. than in Germany. Wrexberg (1941) has found differences between whites and negroes in the incidence of epilepsy, alcoholism, neurosis, psychosis, etc., but all the differences were explicable on other grounds than of racial inborn factors.

Manic-Depressive Psychoses.

Little new work is to hand on this subject, the most interesting being a report by Tomasson (1941). Tomasson had personally seen nearly all the manic-depressives in Iceland for the past nine years. Annual incidence is about 0·14 per cent., and the total probability of developing the disease before

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70 is 0·07, i.e. about 20 times higher than in other countries for which statistics are available. All the descendants of the grandparents of 25 manic-depressives were investigated, comprising 2,463 individuals; in this group the frequencies both of manic-depressive psychoses and of psychiatric abnormality were no greater than in the general population. Among the sibs of the propositi 7 per cent. were manic-depressive, corresponding to the general Icelandic population, and to the frequency of manic-depressive psychoses in the sibs of manic-depressives as observed by Rüdin and Strömgren. The author considers his findings throw doubt on the significance of any heredity factor in the aetiology of manic-depressive psychoses. The results are anomalous, and the Icelandic population is a small and isolated one in which the distribution of genes may well be different from what it is in larger inter-breeding communities. Accordingly, any theoretical conclusions would be premature.

Myerson and Boyle (1941) have investigated the incidence of insanity in the families of certain socially important and wealthy individuals admitted to a superior private mental hospital in New England. They quote the observation of Landis and Page that manic-depressive psychoses are responsible for 16·7 per cent. of first admissions to private hospitals and only 12·9 per cent. of first admissions to state hospitals. They add that manic-depressive psychoses are many times as frequent as schizophrenia in private consultative work. Their observations tend to support the idea that manic-depressive psychoses have a superior social distribution. In the first six families studied, they found 31 manic-depressives to 5 questionable schizophrenics. The families included state governors, members of Congress and Senate, ambassadors, etc., and other talented executives. The authors emphasize the value of a hypomanic temperament or hypomanic periods for great achievement.

Schmidt-Kehl (1939) has investigated the frequency of manic-depressive psychoses in the grandchildren of manic-depressives. The material, which is very small, yields an expectation of 24 per cent. for the children and 3 per cent. for the grandchildren.

Endogenous Psychoses.

German workers continue to accumulate the results of investigation of the frequency of the endogenous psychoses in the general population. Any one such individual investigation is necessarily based on a relatively small sample and leads to inconclusive results, but as this work is accumulated the information becomes precise and reliable. Schade (1941) has investigated the frequency of neurological and skeletal abnormalities in an isolated peasant population; the report is in summarized form. The work of Grobig (1939) has already been referred to.

Formanek (1939*a*) has given a provisional report on an investigation into the relatives of persons suffering from symptomatic psychoses. Fifteen thousand such cases were gathered from all over Germany, 500 specially chosen, and the data on the first 117 are given. The incidence of endogenous psychoses was very high—8·4 per cent. in the sibs—suggesting that a high proportion of the "symptomatic" psychoses were, in fact, endogenous. The paper meets with criticism from Bostroem and Thiele, which appears to be justified only

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in part. Formanek (1939*b*) has also described the family of two parents, one of whom had schizophrenia and the other a pure delirium. One of the children developed a chronic paranoid schizophrenia, the other six remained well.

Kraulis (1939) has made an interesting collection of psychotic patients related to one another either as sibs or as parent and child. He gives a detailed clinical description of many of his 66 families, from which one may agree that manic-depressive, schizophrenic, and atypical psychoses may occur in the same family, and that clinical similarities may run across the classical delimitation of clinical types. Kraulis considers that schizophrenia and cyclothymia are probably genetically related, and the distinction between them is quantitative rather than qualitative. It is to be regretted that he has not given some details of all his patients instead of only a selection. Had he followed Zehnder's example, further use of his material for comparison and analysis would have been possible. Systematic collections of this kind are so expensive and time-consuming that they are worth reporting *in extenso*.

Hobbs (1941) has described five pairs of discordant twins of assured uniovularity. In two pairs injury to the brain at birth had produced in the one mental defect, in the other epilepsy. In one pair no environmental cause could be found for the development of *petit mal*. In another pair one sister developed hysterical symptoms, which are associated by the author with a more aggressive and intolerant temperament than that shown by her twin. In the most interesting pair of all a severe depressive illness seems to have been precipitated by psychogenic factors.

Pollock, Malzberg and Fuller (1939) and Pollock and Malzberg (1940) have described their investigations into hereditary and environmental factors in the causation of manic-depressive psychoses and dementia praecox. The first of these reports is a book of 460 pages. The psychiatric social work which has provided the data is slipshod; the genetic principles on which the analysis is carried out are out of date; the statistical treatment involves one fundamental error. The conclusions, which are drawn with great caution, amount to nothing.

Brockhausen (1939) has investigated the first and second degree relatives of 201 propositi suffering from involutional depressive psychoses. Where the illness was of a phasic and recurrent form, the incidence of manic-depressive and schizophrenic psychoses in the relatives was very much what it might have been expected to be had the propositi been ordinary manic-depressives. These excluded, the remainder of the material is divided into two groups of persons with and without a well-marked paranoid colouring to the psychosis. Both groups show a much lower incidence of manic-depressive psychoses than the phasic cases; the chief difference between them lay in the higher incidence of schizophrenic psychoses in the relatives of the paranoid patients. The author concludes that the non-phasic, non-recurrent depressive psychoses of the involution cannot be considered as manic-depressive in nature.

Leonhard (1939) has provided an interesting discussion of the atypical psychoses (Kleist's formulation). He considers that most of these forms are to be regarded as endogenous, and says that many show a higher degree of tainting than schizophrenic psychoses; he has observed that whenever he

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finds the relatives of a schizophrenic to show a high incidence of psychosis the psychotic pictures are nearly always atypical.

Organic Psychoses.

The work done on the organic psychoses is small in volume and mostly of a non-systematic kind. English (1942) has described seven cases of Alzheimer's disease with clinical and pathological findings. In four of these the family history was negative, in one unobtainable; in the remaining two the mode of inheritance resembled simple dominance with irregular expression. McMenemey, Worster-Drought, Flind and Williams (1939) have described another case with clinical and pathological findings. The father and paternal uncle developed early dementia, a paternal aunt melancholia. Grünthal and Wenger (1939) have described a family in which the father and three children showed symptoms of Alzheimer's disease. Two of these were personally investigated, and in one the pathological findings are available. The suggestion of a fundamentally dominant mode of inheritance has therefore some support. Hadley (1941) has briefly described two Huntington families, without points of interest. Entres (1939) has carried out a systematic investigation of the 549 sibs of 108 propositi with Huntington's chorea. New points of theoretical interest are not raised. The characteristic simple dominant inheritance is confirmed and a manifestation rate approaching the 100 per cent. level is demonstrated. Pohlisch (1941) points out that Huntington's chorea shows a phenotypic variation with age. The normal age of onset is 35, and then choreic symptoms are the main disturbance; in the twenties a striate rigidity, in the sixties an intention tremor occupy a more prominent position in the picture. It would have been interesting if Entres had examined his large material from this point of view. Once again one must emphasize the desirability of a case-by-case presentation of a systematic collection. Sanders (1941) has briefly described a family of which 16 members suffered from Pick's disease. By responses to Rorschach and intelligence tests, she was able provisionally to recognize some members who only developed a typical picture eighteen months later. The mode of inheritance, as has been found elsewhere, was typically dominant. The family is probably the same as that reported by Sanders, Schenk and van Veen (1939).

Epilepsy.

Investigation of the genetics of epilepsy has been revolutionized by the advent of the electro-encephalograph, and Lennox, Gibbs and Gibbs deserve credit for their pioneer work in its application in this field. A preliminary account of their work was published in 1939 and a fuller description in 1940. They examined 183 relatives of 94 epileptic propositi, and found that 60 per cent. had an abnormal EEG. The findings in the case of the parents were: Both parents abnormal, 19; one abnormal, one doubtful, 5; one abnormal, one normal, 25; one doubtful, one normal, 3; both normal, 3. As they point out, the findings suggest that cerebral dysrhythmia is inherited as a simple dominant. Grounds for objection lie in the fact that the criteria of an abnormal

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EEG are still unsettled among electro-encephalographers, and vary from observer to observer. Different criteria are, for instance, used by Lowenbach (1939), who found abnormal records in 17 out of 37 relatives of two epileptics, by Strauss, Rahm and Barrera (1939), who found in the families of 31 epileptics 7 out of 30 parents and 18 out of 63 sibs had abnormal EEGs, and by Robinson (1940), who in the relatives of 15 epileptics found 3 out of 20 parents and 9 out of 15 sibs had abnormal EEGs. Strauss *et al.* consider that epileptics can be divided into two groups, those with and those without abnormal EEGs in their relatives. Investigations of the twins of epileptics have been reported by Lennox, Gibbs and Gibbs (1942) in summary form. They show that the diagnosis of ovularity can be made with a high degree of certainty by the EEG. They report 15 pairs of epileptic twins, of whom 11 were uniovular. Seven of these were discordant as regards epilepsy, but concordant in the electrical abnormalities. In only one pair was one twin normal in every respect, while the twin sister had fits and showed a focal dysrhythmia ; this patient recovered after six months. In this paper also the authors add further results to their investigations of parents of epileptics, which now reach : both parents abnormal, 43 ; one abnormal, the other doubtful or normal, 71 ; both normal or doubtful, 40. These are approximately the proportions one would expect if dysrhythmia were due to a single dominant gene with incomplete manifestation.

Lennox (1942) has examined the relationship between epilepsy and mental defect. He found that of 1,905 epileptic patients 2 per cent. were of above average intelligence, 62 per cent. average, 22 per cent. slightly sub-average, 12 per cent. definitely, and 2 per cent. markedly deteriorated. This is obviously a very abnormal distribution. If epileptic seizures and mental defect have any common genetic basis, defective epileptics should have a larger frequency of affected relatives than mentally normal epileptics, and the evidence should be strongest in those in whom mental defect was present from birth. He finds the incidence of epilepsy among the relatives of epileptics to be : of those mentally defective at birth, 5·9 per cent. ; of those normal at birth and now deteriorated, 3 per cent. ; of those normal at birth and now, 2·4 per cent. The effectiveness of the hereditary factor is likely to be shown in early onset of seizures. The frequency of epilepsy among the mentally defective epileptics whose fits began between 0 and 4 is 8·8 per cent. ; 5 to 9, 7·0 per cent. ; 10 to 19, 5·1 per cent. Among the relatives of those normal at birth the corresponding frequencies are : 0 to 4, 4·3 per cent. ; 5 to 9, 2·7 per cent. ; 10 to 19, 2·6 per cent. ; 20 to 29, 1·7 per cent. ; 30 and over, 1·0 per cent. This evidence, though expressed in a statistically objectionable form, seems to be important. The genetic interpretation, however, is possible along many lines.

The views of Lennox, Gibbs and Gibbs on the inheritance of epilepsy may be summarized as follows. Both symptomatic and idiopathic epilepsy will as a rule not occur without the physiological basis of a dysrhythmic brain. The tendency to dysrhythmia of the appropriate kind is inherited as a simple dominant. Epilepsy may then be released by the impact of the environment in some form. A development of this theory, which has much to recommend it

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for its simplicity, has been suggested by Whitteridge (1942), i.e. that the manifestation of epilepsy will depend as a rule on the dysrhythmic gene being present homozygotically. We have not yet sufficient data for judgment to be passed on these hypotheses.

Neurosis and Psychopathy.

It seems likely that electro-encephalographic work will also throw light on the genetics of psychopathic personality, as is instanced by the work of Hill and Watterson (1942), who found that of 151 psychopaths of all kinds 48 per cent. had abnormal EEGs, and that of a more restricted group of 66 aggressive psychopaths 65 per cent. had abnormal EEGs.

Felix Brown (1942) has reported an inquiry into the family history of a group of patients suffering from anxiety state, hysteria, and obsessional neurosis, and also of a group of controls. In the parents of the patients, the frequencies of anxiety states, hysteria and obsessional neurosis were respectively: I (anxiety neurotics), 21·4 per cent., 1·6 per cent., 0·0 per cent.; II (hysterics), 9·5 per cent., 19·0 per cent., 0·0 per cent.; III (obsessional neurotics), 0·0 per cent., 0·0 per cent., 7·5 per cent. The corresponding figures in the sibs are, in the same order: I, 12·3 per cent., 2·2 per cent., 0·9 per cent.; II, 4·6 per cent., 6·2 per cent., 0·0 per cent.; III, 5·4 per cent., 0·0 per cent., 7·1 per cent. There were also considerable incidence rates of depressive states and of persons of abnormal personality in the relatives of all groups. Brown concludes that, while his findings are against any simple Mendelian inheritance, they are practically conclusive of the significance of hereditary factors. The importance of the environment cannot, however, be neglected. The three types of neurotic state distinguished are probably genetically related to one another, and the development of a neurosis probably depends on the combination of a number of distinct genes, many or all of which in other combinations may be compatible with normal psychiatric make-ups.

The problems of genetic investigation have been discussed in general terms by Stumpfl (1939*a*, *b*). No factual data are provided. The same is true of Riedel's long paper (1939). He says that in studying two groups of psychopaths, "geltungsüchtige" and "asthenische," roughly comparable to the hysterical and inadequate types of British psychiatry, he has found very different familial relationships. The specific qualities that characterized the first were five times as common among their relatives as was the case with the second group. Schröder (1939) has described six pairs of female twins, of whom at least one had drifted into a life of profligacy during or soon after adolescence. Two of these pairs were binovular and concordant, both in respect of character and social behaviour. The remainder were binovular, and of them three showed a considerable degree of discordance in both respects, while one was concordant. The author considers that the sexual downfall of young girls depends to a considerable extent on their personalities.

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* Of no significance for this study.
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THE ANATOMY OF THE NERVOUS SYSTEM.

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Owing to the difficulties of investigating the sensory organization of the nervous system experimentally, for many years experimental neurologists tended to direct their attention rather to the motor mechanisms, for these can easily be studied and recorded objectively. During the last few years, however, research investigations have been more concentrated on the anatomical basis of sensation and, accordingly, this review will be mainly concerned with this aspect.

Cutaneous Sensation.

In 1940, Woollard, Weddell and Harpman published the results of their work on the neuro-histological basis of cutaneous pain, based on the study of methylene blue preparations correlated with physiological observations. They found that cutaneous pain in Man is subserved only by the finer medullated and non-medullated nerve fibres bearing free endings, and that these fibres and endings, which are specific, are arranged in a plexiform interlocking manner in the skin. They also determined that, contrary to Waterston's earlier conclusion that cutaneous pain has no basis in the epidermis, it can in fact be elicited from the deeper layers of the epidermis as well as the dermis. However, it seems that pain receptors in the epidermis are comparatively few. Fibres and endings morphologically identical with pain receptors are also to be found in the adventitia of blood-vessels, and supplying an accessory innervation to encapsulated touch receptors as well as to nerve endings subserving pressure, cold and proprioception. Incidentally the authors confirm the earlier observations of Woollard that pressure, warmth, touch, cold and pain are represented in the skin in punctate form, and that each primary modality of cutaneous sensation is related to a receptor of specific morphological type. They stress the fact that the theory of punctate sensibility must be interpreted from a three-dimensional point of view, and they find no anatomical basis for Head's classic theory of protopathic and epicritic systems. The paper contains an excellent composite diagram illustrating the innervation of the human skin in relation to punctate sensibility.

Continuing the field of work opened up by Woollard, Weddell (1941*a*) has further studied the pattern of cutaneous innervation in Man and lower animals. He finds a similar pattern of cutaneous nerve plexuses in widely different vertebrates, but there is a progressive differentiation of nerve endings. Thus in *Acanthias* only one type of ending was found, and in the rabbit two, while in

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monkeys and Man there are multiple types. The same author also showed that each unit area of skin is evenly innervated by fibres approaching it from all directions, and that this arrangement explains the concentric shrinkage of an area of anaesthesia which occurs during the regeneration of a cut sensory nerve. Further, he was able to demonstrate that the distance between neighbouring receptors of pain, as determined histologically, bears a close relation to the limen of two-point discrimination for this sensation. In the same paper a description is given of the different patterns of sensory loss after nerve root, nerve plexus and nerve trunk lesions in Man, the value of which for the diagnosis of nerve lesions is indicated. Incidentally it may be noted that the frequent occurrence of recurrent nerve fibres in the trunks of sensory nerves serves to explain how it is that stimulation of the distal stumps of a completely divided cutaneous nerve may sometimes give rise to sensation.

Another interesting feature to which Weddell draws attention (1941*b* and 1941*c*) is the multiple innervation of sensory spots in the skin. It seems that, for example, each single group of hair follicles is innervated by two or more separate fibres which approach it from different directions. Meissner's corpuscles usually occur in compact groups, and a cold-spot overlies two or more groups of Krause's end-bulbs. It is believed that this normal condition serves to explain the " protopathic " phase which occurs in the recovery from sensory loss, for in the course of regeneration nerve fibres will arrive at each separate spot at different times because they approach it from different directions, and the ultimate course followed by the individual fibres will necessarily be of different lengths. Thus, during regeneration there will be a phase in which each sensory spot is innervated by a single fibre instead of multiple fibres. In this phase, recognition of graded stimuli and accurate localization will hardly be possible. Such an anatomical condition in the course of regeneration has actually been demonstrated histologically in a patient by Weddell. Reference should here be made to a paper by Weddell, Guttmann and Gutmann (1941), in which attention is called to another phenomenon which may complicate the clinical picture during the regeneration of a sensory nerve. This is the experimental demonstration that the initial shrinkage of an area of sensory loss (which may commence soon after injury) is brought about by the outgrowth into the area of nerve fibres from the surrounding intact cutaneous plexuses.

Just as Head's postulate of a double system of cutaneous nerve fibres to explain the phenomenon of protopathic and epicritic sensation has been shown by Woollard, Weddell and their co-workers to have no anatomical basis, so Lewis's conception of a separate organization of fibres to subserve his " nocifensor " mechanism has not been confirmed by these histological studies. It is some years ago that Lewis elaborated his hypothesis of a nocifensor system (see his lectures published in 1937), but in a recent book (1942) he deals with it at some length. However, it has received adverse criticism from Walshe (1942) in a general review of the anatomy and physiology of cutaneous sensation.

The relation of the sensations of tickling and itching to other sensory modalities of the skin, and their anatomical basis, still remain somewhat obscure. It is generally held either that they involve both the elements of touch and pain, or that they represent the finer gradations of pain only. The

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latter view is supported by the fact that in the affected regions in syringomyelia the sensation of superficial tickle is abolished together with that of pain, while that of light touch remains intact. Zotterman (1939) has studied the problem experimentally by electro-physiological methods, and concludes that tickling and itching sensations are mediated by thin afferent fibres of the same type as those which are known to mediate pain. It appears also that in cases of trigeminal neuralgia treated by Sjöqvist's operation of trigeminal tractotomy (Sjöqvist, 1938) there may be complete analgesia with an intact tactile sensibility, and over the same area tickling reactions are abolished.

General Sensory Paths in the Spinal Cord and Brain-stem.

It is well known that general sensory impulses are carried up in the spinal cord by two main paths, the spino-thalamic tracts and the posterior column tracts. The former convey those impulses which underlie pain and temperature and the coarser aspects of tactile sensation, while the latter transmit proprioceptive impulses and those impulses which subserve the finer aspects of tactile sensation, including tactile localization and discrimination. The course of the spino-thalamic tract in Man has lately been studied by Walker (1940*a*) in two patients who died shortly after chordotomy. The fibres, after arising from cells in the posterior horn, pass across the mid-line in the anterior commissure to the opposite anterior column. As they ascend they become more laterally situated, partly because more fibres of the spino-thalamic tract are being added at higher segments, displacing laterally those from lower segments. There is thus a topical localization within the tract, in the sense that the fibres from the lowest segments are situated at the periphery of the cord. There may be a varying admixture of the fibres conveying different categories of sensory impulse, "temperature fibres," predominating dorsally and "touch and pressure fibres" ventrally, while "pain fibres" occupy an intermediate position. It is of some importance to note, also, that in the cervical region of the cord the sacral fibres lie practically lateral to the pyramidal tracts, and thus they may be spared in upper dorsal or cervical chordotomies in which the incision is made 1 to 2 mm. anterior to the ligamentum denticulatum. As regards the topical arrangement of the spino-thalamic tracts, Walker's observations confirm those made in the previous year by Hyndman and Van Epps (1939) on the basis of anatomico-clinical studies. In the brain stem Walker found that the spino-thalamic tract lies just ventral to the descending nucleus and root of the trigeminal nerve, and further up just dorso-lateral to the inferior olivary nucleus. In this position it has been sectioned surgically for the relief of intractable pain (Schwartz and O'Leary, 1941). In the pons the tract runs immediately medial to the middle cerebellar peduncle and lateral to the medial fillet. In the midbrain it turns dorsally and comes to lie right at the periphery, just above the lateral sulcus. This peripheral position makes it possible to interrupt also at this level all the pain pathways from the entire opposite half of the body. Indeed, such a surgical procedure has been put into practice by Dogliotti (1938). Walker (1942*a*) has described a technique for mesencephalic tractotomy which differs from that of Dogliotti in placing

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the lesion further up in the mid-brain. The advantages are the greater ease of surgical approach, and the fact that at this level the surface markings allow the position of the pain tracts to be more precisely located. Both the spino-thalamic and the secondary trigeminal paths can be interrupted at the same point by a comparatively small lesion. Walker (1942*b*) has accurately mapped out the somatotopic localization of the spino-thalamic and trigeminal tracts in the mesencephalon by experimental studies on the monkey's brain.

Approaching the thalamus by passing just medial to the brachium of the inferior colliculus, the spino-thalamic tract turns laterally to become dispersed in the basal portions of the ventral thalamic nucleus. The topography of the termination of the fibres conveying impulses from different parts of the body could not be determined in Walker's human material, but it may be supposed that it probably corresponds to the arrangement indicated by earlier experiments in the monkey (Le Gros Clark, 1936; Walker, 1938*a*), i.e. those originating from the more rostral parts of the body terminating medially and those from the caudal parts ending laterally.

During the period covered by the present review there has been little further study of the course of sensory impulses conveyed by the posterior column tracts of the spinal cord. For the sake of completeness, a brief reference may be made to the slightly earlier work of Ferraro and Barrera (1934, 1936*a* and *b*) because of its anatomical importance. These investigators have confirmed that the fibres from the lower extremities terminate in the nucleus gracilis, and that the latter sends its fibres entirely to the medial lemniscus. Consequently a lesion of the nucleus gracilis involves no appreciable cerebellar connection of the lower extremities. On the other hand, the main cuneate nucleus, which receives impulses from the upper extremities, possibly sends some fibres to the cerebellum besides those which enter the medial fillet. But it is difficult to say how far this is the case, for the external cuneate nucleus (nucleus of Clarke-Monakow), which lies immediately adjacent to the main cuneate nucleus and which receives fibres of the posterior columns from the cervical segments of the cord, does send its efferent fibres to the cerebellum. Thus, when a lesion of the posterior column nuclei involves also the external cuneate nucleus, the resulting symptoms are more pronounced because of the involvement of the cerebellar component. A study of the topography of fibres in the medial lemniscus by the same authors has shown that in the interolivary space of the medulla the fibres from the nucleus gracilis occupy the most ventral position, and those from the nucleus cuneatus the dorsal portion. More frontally the fibres from the nucleus gracilis are displaced laterally and ventrally and come to occupy the ventro-lateral angle of the medial lemniscus, while the fibres from the nucleus cuneatus occupy the dorsomedial portion.

A recent experimental study on the topical organization and termination of the fibres of the posterior columns in the macaque monkey by Walker and Weaver (1942) confirms the earlier work of Ferraro and Barrera.

The question repeatedly arises whether fibres of the medial fillet terminate in other parts of the fore-brain besides the thalamus. For example, some authors in the past have described terminal connections with the hypothalamus, but, in spite of careful studies, these connections cannot be said to be satis-

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factorily established. On the other hand, Dusser de Barenne and McCulloch (1939), using their method of local strychninization with the recording of electrical activity, have adduced evidence which suggests that some fibres from the nucleus gracilis and cuneatus may extend directly to the cerebral cortex without the intervention of the thalamus, while others terminate in the globus pallidus. These conclusions seem to be out of harmony with the general plan of organization of the sensory systems of the brain as this has been conceived in the past, and, while of course they should not be rejected on this account, they will no doubt require corroboration before their final acceptance.

Trigeminal paths.—Recent interest in the technique of trigeminal tractotomy for the relief of intractable neuralgia has focused attention on the anatomy of the trigeminal paths. As is well known, it is commonly held that the descending tract of the fifth nerve subserves pain and temperature sensations. This conception receives some confirmation from the observations of Sjöqvist that the tract contains a great preponderance of very fine fibres (less than 3μ in diameter). However, more careful studies of the sensory loss following tractotomy has led to some qualifications of the usual view. Walker (1939*b*), for example, has reported slight impairment of tactile sensation in such cases, and points out that similar observations are also to be found in earlier literature. He concludes, therefore, that the spinal tract carries sensation of pain, heat, cold, deep pressure-pain, and to a slight degree touch. It may be noted in this connection that, even if fine fibres predominate in the spinal tract, there are also varying numbers of larger fibres, and it may be presumed that the latter mediate tactile impulses. Similar conclusions have been reported by Grant, Groff and Lewy (1940) and Weinberger and Grant (1942). The latter found evidence that pain fibres from the oral mucous membrane lie most medially in the tract and that, while the general distribution of fibres is in terms of the peripheral divisions, all three divisions may descend to a point below the level of the obex. In several of these cases the authors found on post-operative sensory examination that there was considerable discrepancy in the relative degree to which pain and temperature were affected; hence they conclude (in agreement with some earlier observers) that separate pathways probably exist in the tract for these sensory modalities.

Some details of surgical importance regarding the anatomical relations of the spinal tract of the fifth nerve are given by Olivecrona (1942). This author also points out that the results of tractotomy are often by no means as successful as commonly supposed, partly because of the troublesome paraesthesiae which may develop in the anaesthetic areas.

The secondary trigeminal paths have been studied anew by Walker (1939*a*) in the macaque monkey, employing the Marchi method. Fibres from the spinal nucleus of the fifth nerve decussate and run up in the white matter between the inferior olivary nucleus and the pyramid; in the pons they lie at the lateral margin of the medial lemniscus. Then, accompanying the spinothalamic tract through the mid-brain, they end in the medial portion of the nucleus ventralis posterior of the thalamus. No evidence was found in the monkey for the existence of a dorsal secondary trigeminal tract, described more than forty years ago by Wallenberg and v. Gehuchten, and Walker

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suggests that this pathway possibly serves to carry fibres from the nucleus of the fasciculus solitarius, conveying sensory impulses from the pharynx, larynx and the adjacent tongue region. From the main sensory nucleus of the trigeminal nerve, it seems that two groups of fibres probably arise. One crosses the midline and follows the medial lemniscus, lying on its dorsal and medial aspect to terminate finally in the dorso-lateral portion of the arcuate nucleus of the thalamus. The other group, which passes through the dorsolateral part of the reticular substance, is partly crossed, but mainly uncrossed. While some of these fibres appear to terminate in the pons and mid-brain, many end in the medial part of the arcuate nucleus.

A clinical and pathological study of the systematization and central connections of the trigeminal nerve in Man has been presented by Smyth (1939). This author finds definite evidence to support the view that the ophthalmic division of the fifth nerve is represented in the lowest part of the spinal tract, and the mandibular division in the highest, and he points out that these observations are incompatible with the opinion that the representation in the tract is in terms of concentric zones converging on the nose and mouth. No evidence was found of a dorsal quinto-thalamic tract in Man. In the medulla the secondary path probably occupies the ventro-medial part of the medial lemniscus, and in the upper half of the pons it comes into fairly close anatomical relationship with the fibres of the spino-thalamic tract. The abolition of the corneal reflex after operative section of the spinal tract indicates that the afferent arc descends to its most caudal part. In a recent paper by Harrison and Corbin (1942) tactile impulses were traced into the spinal tract of the fifth nerve of the cat by means of an oscillograph. The results of these experiments show that impulses originating in the ophthalmic division reach as far down as the caudal part of the first cervical segment, those from the maxillary area as far as the rostral part of the first cervical segment, and those from the mandibular area as far as the junction of the medulla and cord. Moreover, in the tract the ophthalmic fibres assume a ventral position, the mandibular fibres a dorsal position and the maxillary fibres an intermediate position.

One of the elements of the trigeminal nerve, the mesencephalic root, has aroused discussion and controversy for many years. Two main theories have been held regarding its function, both based on quite inadequate evidence. One of these is that the root conveys proprioceptive impulses from the extrinsic ocular muscles, and the other that it conveys proprioceptive impulses from the masticatory musculature. The controversy seems now to have been finally settled by the work of Corbin and Harrison (1940). Using the Clarke-Horsley stereotaxic instrument for localization, these authors picked up the action potentials in the mesencephalic root in cats after applying various peripheral stimuli. They found conclusive evidence that the root (and its nucleus) is concerned with the reception of impulses from stretch receptors in the masticatory muscles and pressure receptors related to the teeth and in the hard palate. It thus appears probable that these impulses play an inhibitory role, and, in constituting the afferent side of masticatory reflex arcs, co-ordinate and control chewing movements. No action potentials could be elicited from the mesencephalic root as the result of stretching the extrinsic

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ocular muscles. The precise anatomical distribution of the fibres of the mesencephalic root of the fifth nerve has been determined by Corbin (1940), using the Marchi method after destruction of the mesencephalic nucleus with the Clarke-Horsley stereotaxic instrument. The fibres were found to be distributed to the ethmoidal branch of the ophthalmic division, the palatine and superior alveolar branches of the maxillary division, and the pterygoid, temporal, masseteric and inferior alveolar branches of the mandibular division.

The Thalamus.

The thalamus constitutes in general a system of relay stations whereby diverse somatic afferent impulses are projected on to the cerebral cortex.* It is, so to speak, a filter through which these impulses must pass before they reach the highest integration levels of the central nervous system. In the past ten years the structural analysis of the thalamus has been greatly advanced, partly by the delineation of its component nuclei and their fibre relations in preparations of normal material, partly by tracing the termination in the various nuclei of ascending tracts from the spinal cord and brain stem, and partly by establishing the relation of the nuclei to the different cortical areas of the cerebral hemispheres. All this work has served to demonstrate that the thalamus is composed of a congeries of functional "centres" each with its specific afferent and efferent fibre connections; in other words, it has thrown a great deal of light on the nature of the functional localization which exists in this part of the brain. During the last few years our knowledge has been made more precise by the detailed study of normal, experimental and clinical material.

The nuclear composition and the fibre connections of the thalamus have recently been analysed in a number of different vertebrates: *Amblystoma* (a teleostean fish) (Herrick, 1939); *Corydora* (Miller, 1940); the American water-snake (Warner, 1942); Virginian opossum (Bodian, 1939, 1940, 1942); pig (Solnitzky, 1938); sheep (Rose, 1942); chimpanzee (Walker, 1938*c*); rat (Lashley, 1941); *Hyrax* (Ibrahim and Shanklin, 1941); phalanger (Goldby, 1941, 1943); and rabbit (Stoffels, 1939). A study of these papers will show that in all mammals the thalamus is constructed on the same plan. There is, for example, no striking difference between the thalamus of marsupials and that of eutherian mammals. There are, of course, differences in the relative development of individual nuclear elements, and these show a direct relation with the extent and differentiation of the cortical areas with which they are connected.

A study of a remarkable clinical case in which a diffuse porencephaly had led to almost complete hemidecortication (Le Gros Clark and D. S. Russell, 1940) has shown that, in the human brain, practically the whole thalamus projects on to the cerebral cortex. The only elements which remain unaffected by destruction of the cortex are the centre median nucleus and a narrow subependymal zone of small cells lining the third ventricle. It appears, therefore, that the cells of all the other thalamic elements send their axones to

* In this article the term "thalamus" refers to the main part of the diencephalon exclusive of the epithalamus, hypothalamus and subthalamus.

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the cortex and to no other region of the brain—otherwise it would be difficult to explain the total retrograde cell degeneration which occurs after cortical lesions. This anatomical fact is clearly of the greatest significance in the consideration of the part which the thalamus may play in sensory functions, for it appears finally to dispose of any structural basis for Head's conception of the " essential organ " of the thalamus. It likewise disposes of such elements as the thalamo-olivary tract and the thalamo-striate connections which have found their place in text-book descriptions for many years. It may be noted that in lower mammals the thalamic atrophy which follows hemidecortication is apparently not quite so complete as it is in Man (Waller, 1938; Papez and Rundles, 1938; Walker, 1938*a*, 1938*b*). This suggests a progressive " corticalization " of thalamic functions which reaches its acme in the human brain.

Reference may be made to an excellent monograph by Walker (1938*a*) on the Primate thalamus, which gives full information on the subject up to date. Subsequent researches have added more details concerning many of the thalamic nuclei. By the use of electro-physiological methods the topographical representation of the body in the ventral nucleus has been confirmed—that is, the lower limbs are represented most laterally, the upper limbs occupy an intermediate position, and the sensory impulses from the head region are projected most medially (Magoun and McKinley, 1942). The latter terminate in that part of the ventral group of nuclei which is termed the arcuate nucleus, and this element projects on to the lower extremity of the sensory cortex in the opercular region of the hemisphere. Suggestions have been put forward that the arcuate nucleus is concerned, at least partly, with the sensation of taste, but the evidence for this is by no means conclusive.

The ventral group of nuclei may be divided into anterior, middle and posterior parts from the point of view of their ascending connections. It is in the posterior part (nucleus postero-lateralis and nucleus arcuatus) that the fillet systems end. These elements appear to project entirely on to the sensory (post-central) area of the cortex. The middle part receives fibres of the brachium conjunctivum from the opposite cerebellar hemisphere—this has recently been confirmed in the monkey by Crouch and Thompson (1938*b*)—and it projects on to the motor cortex. Experiments by Sjöqvist and Weinstein (1942) suggest that (at least in monkeys and chimpanzees) the cerebellar projections to the thalamus may subserve the recovery of proprioceptive functions following interruption of the medial lemniscus. The afferent connections of the anterior ventral nucleus are not certainly known.

The medial nucleus of the thalamus (n. dorsomedialis) projects on to the granular area of the frontal cortex. The topographical details of these connections have been studied by Walker (1940*c*) in the monkey and by Waller (1940*a*) in the cat, and the same connections have been established for Man by Stern (1943) from the study of a brain in which the frontal cortex had been partly destroyed by a traumatic lesion. These connections of the medial nucleus are of particular interest in relation to problems of functional localization in the frontal cortical areas, more especially because of the modern development of surgical measures for treating certain psychological conditions by the operation of leucotomy. Unfortunately, little is known of the nature of the

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impulses which are relayed on to the cortex by the medial nucleus. Connections have been described with adjacent thalamic nuclei—particularly the lateral and ventral nuclei—but it seems doubtful if these really exist, seeing that all the cells of these nuclei appear to undergo degeneration after hemi-decortication. More certain are the ascending connections which the medial nucleus receives from periventricular fibres which ascend to it alongside the third ventricle, and which probably have their origin in the hypothalamus. On the basis of these connections it was suggested some years ago by the present author (1932) that the medial nucleus provides a mechanism whereby the highest functional levels of the brain are enabled to control the more primitive elements of mental activity, such as are expressed in emotional reactions, and that the frontal cortical areas represent a final product of cerebral development, where the activities of the purely cortical mechanisms underlying the intellectual components of personality are equated with the activities of the hypothalamic region, which are in some way associated with the more fundamental and primitive components. No doubt this speculative hypothesis is an oversimplification of a process which is clearly very complicated and which must involve many parts of the brain, but it seems probable that the medial nucleus may play at least a part in such integrative functions. In a recent clinico-pathological study of thalamic tumours, Smyth and Stern (1938) observe that in cases where gliomas invade the thalamus from the ventricular wall, involving the medial nuclei and periventricular connections, mental deterioration is an early sign. Further detailed studies of clinical cases in which the medial nucleus is involved are required to elucidate its precise functions.

The centre median nucleus of the thalamus remains a mystery. As already stated, this well-defined element is unaffected by cortical lesions, and it may thus be assumed that it has no cortical connections. A clinical case of complete cortical deafness following bilateral thrombotic lesions in the external capsule has been described by Le Gros Clark and Ritchie Russell (1938) in which the centre median nucleus had undergone complete atrophy, and the suggestion was put forward that it may have connections with the insular cortex which had hitherto escaped notice. However, an experimental investigation undertaken to inquire into this possibility by the same authors (1939) showed no evidence of such connections. Possibly it may project on to elements of the corpus striatum (as suggested by some previous workers), but the evidence for this is far from conclusive. The consensus of opinion at present seems to be that the centre median nucleus is purely a thalamic association centre, sending its efferent fibres to the surrounding thalamic nuclei (Crouch, 1940). In this connection reference may be made to the observations of Magoun and McKinley (1942), who investigated the termination of ascending sensory tracts in the thalamus by the oscillographic recording of potential changes in the latter after stimulating various peripheral nerves. They found that the centre median nucleus is actually "fired" by the peripheral stimulation, but the potentials are of a character significantly different from those of the lemniscal systems, and moreover occur considerably later. It may be assumed, therefore, that the centre median discharge is the result of activity delayed in some relay system.

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For a general experimental study of the efferent connections of the various thalamic nuclei in the monkey, reference may be made to papers by Crouch and Thompson (1938*a*) and Crouch (1940). The anatomical relationship of the thalamic nuclei to the "thalamic syndrome" has been lately discussed by Smyth and Stern (1938), Kleist and Gonzalo (1938) and Walker (1938*b*).

Visual Paths.

In the past few years a considerable amount of work has been completed on the detailed analysis of retinal connections and visual centres. Of quite outstanding importance is a book by Polyak (1941) on the retina, in which he records at some length his studies of retinal histology. These studies provide a sound basis for the investigation of the retinal mechanisms involved in the perception of light and colour. Particularly interesting is the author's recognition of several types of bipolar cell, each of which has a different pattern of intra-retinal connections, for it is suggested that these elements may constitute the analysers postulated by the classical trichromatic theory of colour vision.

The main terminal stations of the optic tract are well known to be the lateral geniculate body and the tectum of the mid-brain. Connections with the basal regions of the fore-brain in lower mammals have also been described by way of the so-called anterior and posterior accessory optic tracts. It now seems doubtful whether the former is an independent terminal connection of the main tract, and in spite of recent studies (Gillilan, 1941) it is not definitely established that the latter is present in the higher mammals (see Jefferson, 1940).

In the higher primates a large proportion of the fibres of the optic tract end in the lateral geniculate body. In Man, apes and catarrhine monkeys this is composed of six layers of cells, of which three receive homolateral retinal impulses and three heterolateral. It has been found by the method of trans-neuronal degeneration that from every spot in the central part of the retina fibres pass back to terminate in three layers of cells in the geniculate body, and it is inferred, therefore, that the conducting unit of the optic nerve is a unit of three fibres, each fibre passing to a separate cell layer. The interest of this observation lies in its possible relation to the trichromatic theory of colour vision (Le Gros Clark, 1941*a*).

The precise mode of termination of optic fibres in the lateral geniculate body of the rabbit and cat has recently been studied by Glees (1941, 1942) by making use of the characteristic degenerative changes which occur in the optic terminals a few days after section of the optic nerve. In both these animals each optic fibre is in terminal relation with a number of geniculate cells (ten or more), and there appears to be a considerable overlap. Moreover, a single geniculate cell receives a large number of terminals, estimated (in the cat) at about forty. In the monkey the condition is very different (Glees and Le Gros Clark, 1941). Here each optic fibre commonly terminates in a spray of five or six branches, each of which ends in synaptic relation with one geniculate cell, and in no case was it possible to find more than one synaptic contact with each cell. Clearly, such an arrangement would provide for the utmost

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precision in the recording at the geniculate level of a retinal image. In the cat, on the other hand, the profusion of synaptic contacts, together with the overlap of the terminals of different optic fibres, would presumably provide an anatomical basis for a high degree of sensitivity even in low intensities of illumination. The work of Glees and Le Gros Clark provided the first *direct* evidence that crossed and uncrossed retinal fibres end in different cell-laminae of the geniculate body, and also indicated that the terminal of each fibre is confined to one lamina only. Thus there appears to be no anatomical basis for a fusion at the geniculate level of crossed and uncrossed retinal impulses. A similar conclusion has been reached by O'Leary (1940) on the basis of Golgi studies of the cat's brain. These anatomical observations receive confirmation from electro-physiological methods of investigation, for Bishop and O'Leary (1940), by leading off from the geniculate body of one side in the cat while stimulating simultaneously or in succession both optic nerves with single shocks, found no evidence of any phenomena of interference or facilitation which might suggest fusion of retinal images at the geniculate level.

In the Primates it seems that destruction of the visual cortex leads to complete degeneration of all the cells of the geniculate body. Hence it may be assumed that these cells are entirely concerned with the cortical projection of retinal impulses—i.e. there are no intercalated cells which might subserve purely intrageniculate neural activities. It has been known for some time that minute lesions in the visual cortex of the monkey lead to retrograde atrophy involving all six cell-layers of the geniculate body—in other words, it may be inferred that the conducting unit of the optic radiations is a 6-fibre unit. Hence, while the impulses from corresponding points in the two retinae evidently remain distinct within the limits of the geniculate body, they must be brought into the most intimate relation as soon as they are projected on to the cortex, and it may be inferred that the cortical mechanism for the fusion of two images necessary for stereoscopic vision is very localized spatially.

For further details regarding recent work on the visual paths, reference may be made to Le Gros Clark (1942*a*, 1943).

Sensory Areas of the Cerebral Cortex.

By studying the effect of local strychninization of the sensory cortex on the electrical activity of the thalamus, and the effect of local strychninization of the sensory thalamic nuclei on the electrical activity of the cortex, Dusser de Barenne and McCulloch (1938*b*) have provided further evidence of the reciprocal anatomical connections which exist between each nucleus and its corresponding cortical area. Moreover, they found that sharp functional boundaries are present between the adjoining sensory systems. It is pointed out that the cortico-thalamic neurones (the existence of which seems finally to be established by their methods) can hardly provide the basis for the inhibitory functions originally ascribed to them by Head, for their stimulation leads to an increase and not a decrease in the electrical activity of the thalamic cells. The same authors (1940) have shown that the spontaneous electrical activity of the cortex remains after decapitation and decerebration, but vanishes when

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the cortex is separated from the thalamus. This observation further emphasizes the importance of the reciprocal thalamo-cortical connections in the establishment of a common functional unit.

For a number of years it has been contended by anatomists—on the ground of histological and experimental studies—that the general sensory area of the cortex (receiving impulses conveyed by the fillet system) is probably quite limited in extent and (in the higher Primates) practically confined to the post-central gyrus. On the other hand, physiologists have been reluctant to accept such a clear-cut and restricted type of localization; they have depicted the sensory area of the cortex as much more extensive, spreading in the monkey over a considerable part of the frontal and parietal cortex. Lately, however, the conception held by the anatomists has been vindicated by the employment of much more refined physiological methods. By recording the potential waves in the cortex after the excitation of skin receptors by normal stimuli, Adrian (1941) has mapped out the somatic sensory area of cortex in the rabbit, cat, dog and monkey. In each case the area appears to correspond precisely with the histological area delineated many years ago by Brodmann (area postcentralis). No evidence for a bilateral representation was found in the cat, dog or monkey. The simplicity and directness of the relay mechanism in the thalamus is suggested by Adrian's observation that signals from tactile receptors are handed on to the cortex without much alteration, though they are accompanied by additional signals from the thalamus which are rather variable. Observations by Woolsey, Marshall and Bard (1942) on the sensory cortex in the monkey (also using electrical methods for recording cortical potentials) have led to results similar to those of Adrian, and, in addition, they have analysed the topographical localization of different regions of the body in the post-central cortex in considerable detail. Reference on the same subject should be made to papers by Bard (1938), Marshall, Woolsey and Bard (1941), and Marshall (1941).

The receptive cortical area for auditory impulses has now been defined with great accuracy in the cat and monkey by the use of a variety of methods—Marchi (Woollard and Harpman, 1939), retrograde cell degeneration (Waller, 1940*b*), combined oscillographic and cyto-architectonic methods (Bremer and Dow, 1939) and electrical methods (Ades, 1941; Ades and Felder, 1941). In the monkey the area is astonishingly small, occupying the upper face of the superior temporal gyrus, and in diameter not more than 12 mm. An anatomical study of a case of complete cortical deafness by Le Gros Clark and Ritchie Russell (1938) indicates that in the human brain the area is correspondingly limited. By the study of surface potentials produced by stimulation of cochlear fibres, Woolsey and Walzl (1941) have presented evidence suggesting that there is a regional localization in the acoustic area of the cat, in the sense that impulses from the basal end of the cochlea are projected on to the anterior part of the area, and those from the apical end to the posterior part, while impulses from intermediate positions end in band-like zones of acoustic cortex between these two limits.

The precise extent of the visual cortex in Man and a number of other mammals has been known for many years, and it has also been established

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that the topographical projection of retinal impulses on to the cortex is organized on a very precise plan. Attempts have more recently been made to analyze the structural basis of visuo-cortical processes, but progress along these lines is slow. Numerical computations show that in the monkey about 1,350 afferent fibres (conveying retinal impulses from the lateral geniculate body) project on to each square millimetre of visual cortex (Le Gros Clark, 1941*b*), compared with 1,700 in the rat (Lashley, 1939). O'Leary and Bishop (1931) have demonstrated that in the rabbit there is an extremely close correspondence between the optically excitable cortex and the anatomically defined area striata. The study of the structural changes which occur in isolated portions of the cortex in the monkey has confirmed, *inter alia*, that the afferent fibres ascend very obliquely into the cortex from the subjacent white matter, while the association fibres are collected in the radiated bundles (Le Gros Clark and Sunderland, 1939), and that the stria of Gennari is predominantly made up of intracortical connections of an entirely local character. The study of Golgi material has enabled O'Leary (1941) to analyse the structural plan of the area striata in the cat, with detailed descriptions of the neurones of which the various cellular laminae are composed and their interconnections. The author found that the distribution of the plexus of afferent fibres is more limited than it is in the rabbit, being almost entirely confined to lamina IV (internal granular layer). He also notes that in the cat the afferent fibres extend over a significant area of the cortex, giving off a number of ramifying collaterals in its course, so that the point-to-point localization between retina and cortex can hardly be as precise as it seems to be in the higher Primates. Perhaps the most conspicuous elements in the visual cortex of the higher Primates are the large "solitary cells of Meynert" (see Le Gros Clark, 1942*b*). Each of these cells has widely spreading basal dendrites which bring it into contact with a relatively extensive area of cortex; indeed, it is estimated that in the monkey the axone of each cell represents a "final common path" for a unit area of cortex of approximately half a square millimetre. The Meynert cells are thus appropriately disposed to serve rapid "mass reactions" from the cortex, that is to say, reactions which rapidly reflect the gross activities of the cortex. Experimental evidence has also been recorded which indicates that the axones of the Meynert cells extend down to the mid-brain to form at least a component part of the cortico-mesencephalic tract.

Organization of the Cerebral Cortex.

In 1938(*a*) Dusser de Barenne and McCulloch studied the interconnections of various parts of the cerebral cortex by the method of local strychninization, combined with the recording of the electrocorticogram over adjacent areas. The application of strychnine to an area *a* of the cortex may "fire" another area *b*, as shown by characteristic potential fluctuations ("strychnine spikes") in the electrocorticogram. The authors have shown that the strychnine acts directly on the perikaryon of a neurone, and that the strychnine spikes are the result of impulses conveyed by the axon through the subcortical white matter to its terminal in the cortex elsewhere. The method has thus proved to be a

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most useful technique for mapping out the course and distribution of association fibres interconnecting the various cortical areas. It has been found that the areas differ considerably in their connections, and in many cases the latter are far less widespread than anatomists have supposed to be the case. For example (Dusser de Barenne, Garol and McCulloch, 1941*a*; Bonin, Garol and McCulloch, 1941) in the monkey area 1 (post-central cortex) sends fibres to areas 4, 2s, 5 and 7, area 6 to areas 4s, 4, 1, 2s, 5 and 7, while area 17 (visual cortex) only sends fibres to the adjacent area 18. Within the limits of certain areas the intra-areal distribution appears to be extremely limited. Thus in area 17 and area 5 the strychnine spikes are restricted to the area actually strychninized and its immediate vicinity. In many other areas, on the contrary, the intra-areal distribution is widespread. In the chimpanzee's brain (Bailey, Dusser de Barenne, Garol and McCulloch, 1941) the organization of the cerebral cortex seems to be much the same as it is in the monkey, except that the distribution of association fibres is considerably less widespread.

A remarkably interesting observation recorded by Dusser de Barenne and McCulloch (1938*a*), and independently also observed by Hines (1937), is the existence of a narrow strip of cortex (4s) along the anterior margin of the motor cortex (area 4) which, when stimulated electrically, chemically or mechanically, leads to a suppression of the electrical activity of the whole of the rest of the cortex, and also to a disappearance of the motor response to stimulation of the motor cortex. The latter has a remarkable latency of about four minutes, and cannot be produced again for many minutes. By making various lesions in the brain, it was discovered that the integrity of the caudate nucleus is necessary for the suppression phenomenon. It was also found that strychninization of area 4s leads to the appearance of typical strychnine spikes in the caudate nucleus. Thus it seems certain that there are cortical cells in area 4s, whose axones terminate either directly or by means of collaterals in the caudate nucleus, even though (Verhaart and Kennard, 1941) it is not possible to demonstrate such an anatomical connection by the ordinary Marchi technique.* The suppression effect produced by the activity of the caudate nucleus appears to take place through the thalamus, for, while the absence of direct caudato-cortical connections is shown by the fact that strychninization of the caudate nucleus produces no strychnine spikes in the cortex, such an experiment does lead to changes in the electrical activity of the thalamus. However, the evidence suggests that the connection of the caudate nucleus to the sensory thalamic nuclei is not a simple direct axonal one, but has relays somewhere in between. Other suppression areas besides area 4s have been mapped out in the monkey's brain (Dusser de Barenne, Garol and McCulloch, 1941*b*), a narrow strip along the anterior border of the premotor cortex (8s), another along the posterior border of the post-central cortex (2s), and yet another adjacent to area 18 (19s). From all but the last of these, direct efferent connections with the caudate nucleus seem to have been established by the method of strychninization. In the course of this work evidence has also been adduced to show

* Since this was written, Dr. P. Glees, working in the author's laboratory, has been able to demonstrate the efferent connection between area 4s and the caudate nucleus by the experimental use of a specialized silver technique.

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that fibres run from area 6 to the putamen and globus pallidus externus, and from area 4 to the putamen.

This recent work on the anatomical relation between the cerebral cortex and the corpus striatum is of outstanding importance, and will no doubt soon lead to a considerable clarification of the role played by the basal ganglia in cerebral functions. It becomes clear now that the corpus striatum is in some fundamental way essential for the normal activity of the cerebral cortex; indeed, it seems to constitute a necessary activating mechanism. This conception is likely to be fruitful in the interpretation of the mental disturbances which often accompany lesions in the region of the basal ganglia.

The Cerebellum.

The morphological analysis of the cerebellum has been a bone of contention for many years, and the uncertainties regarding it are reflected in the different views of the cerebellar subdivisions which are presented to students in ordinary text-books. While previously the cerebellum was commonly subdivided on morphological grounds into three lobes, anterior, middle and posterior, recently there has been a tendency to recognize two main lobes only, anterior and posterior. Yet the former subdivision is no doubt the more reasonable, for it is based on several of the fundamental connections of different areas of the cerebellar cortex. The confusion regarding the subdivisions of the cerebellum has evidently arisen partly because anatomists in the past have expected them to be much more clear-cut than is really the case, and have tried to relate them rigidly to fissures which they have mistakenly supposed to be constant and fixed boundaries between different morphological elements and strictly comparable from one animal to another. It seems also that some anatomists have unwittingly confused the issue by their tendency to separate sharply the older and more recent phylogenetic components of the cerebellum, and this tendency, indeed, applies to several other parts of the brain as well. It would probably save a good deal of confusion if the prefixes "palaeo-" and "neo-" were debarred from use in cerebral morphology altogether.

A comprehensive review of the evolution and anatomy of the cerebellum has lately been published by Dow (1942*b*). For this reason it would be superfluous to deal in great detail with recent studies of cerebellar morphology here, and some of the main points only will be mentioned.

The termination of spino-cerebellar fibres in the anterior and posterior lobes of the cerebellum has been established in a general way for a good many years, mainly on the basis of Marchi studies. By oscillographic methods the distribution of these fibres has now been mapped out with much more precision (Dow, 1939); they have been shown to reach the entire anterior lobe of the cerebellum, the lobulus simplex, pyramid and paramedian lobule, and they are most numerous in the anterior lobe. The work of Brodal and Jansen (1941) also makes it probable that some end in the uvula and perhaps in the nodule.

Cortico-pontine and ponto-cerebellar connections have been studied by Sunderland (1940). This work has thrown considerable doubt on the view held by some previous investigators that specific areas of the cerebral cortex

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project on to specific areas of the cerebellar cortex, for while it appears that cortico-pontine fibres relate different parts of the cerebrum to different parts of the pontine nuclei, the latter project diffusely on to the lobus medius of the cerebellum. Such a conclusion receives further confirmation from the oscillographic studies of Curtis (1940) and Dow (1942*a*).

The olivo-cerebellar system has a point-to-point relationship of a very precise kind, and through it the inferior olive sends fibres to the whole extent of the cerebellar cortex. The details of these connections have been confirmed and extended by Brodal (1940). It may be argued indirectly from the nature of this relationship that the climbing fibres in the cerebellar cortex are the actual terminals of the olivo-cerebellar system, while the mossy fibres are the terminals of the vestibulo-cerebellar, spino-cerebellar and ponto-cerebellar systems.

Vestibulo-cerebellar fibres are related entirely to the basal part of the cerebellum, and according to Dow (1939) end in the flocculus, nodule, uvula and lingula of the cerebellar cortex, as well as in the fastigial nuclei.

The existence of long association fibres connecting distant parts of the cerebellar cortex has been disputed. They have been described on the basis of Marchi material, but the latter is hardly critical enough to provide a definite answer. Electro-physiological methods have now shown that they probably do not exist, for a strong stimulation of a cerebellar folium, sufficient to produce an after-discharge lasting several seconds, fails to modify the electrical activity further than 5 mm. from the site of stimulation (Dow, 1938). On the other hand, short association fibres linking up immediately adjacent folia of the cerebellum are undoubtedly present in abundance.

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PHYSIOLOGICAL PSYCHOLOGY.

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It is proposed in this review to deal only with those aspects of physiological psychology that have an immediate bearing on the problems of human behaviour. Here again two limitations must preclude consideration of much important work in this field, in that endocrinology and the study of cortical potentials have been relegated to the special articles dealing with this subject.

The action of drugs on mental processes has been far too little studied in the past, and the three years under review have added little to our knowledge of a subject which properly understood should, in itself, furnish important clues to most of the problems of human behaviour.

Benzedrine.—The stimulating action of this drug has been the subject of much work from the therapeutic angle, but its alleged effects on mental processes are still very far from being objectively verified.

Mann and Quastel (1940) have been able to suggest a biochemical basis for the alleged stimulant action. They found that the oxidation of glucose by the cerebral tissue is inhibited by tyramine, isoamylamine and a number of similar amines. Benzedrine competes reversibly with tyramine and the related amines for amino-oxidase, and thus reduces the aldehyde-forming power of the amines and the resultant inhibition of glucose oxidation. It would be interesting to inquire in view of the almost specific therapeutic actions of benzedrine in neurology whether there is any evidence of abnormal aldehyde formation in this condition. These authors have studied the excretion and detoxication of the drug, which Beyer (1939) has shown to have a prolonged action on the general metabolism. Using a diazo titration colour reaction they found that less than half of the injected dose is excreted in the urine. The effect of benzedrine on intellectual activity has been the subject of much discussion. Davidoff and Reifenstein (1939) found that the results of benzedrine administration were characterized by uncertainty and impredictability. Carl and Turner (1939) found that the drug had little effect on accuracy, but that speed of work was increased. Holch, Thornton and Smith (1939) found that the improvement effected by benzedrine on the tapping time, handgrip and steadiness tests was greater than that obtained by caffein administration. Golla and Blackburn (1939) introduced a new method in their investigation of the effect of benzedrine on speed of movement and simple mental processes. They were impressed by the great difficulties encountered in any attempt to demonstrate alterations of time in performance with the usual tasks set in psychological experiments, due not only to awareness of the expected result, but to the difficulty of establishing a norm. For this reason whilst the subject was undergoing the usual standard tests, a number of habitual reactions

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were timed without the subject being aware that this was being done. Thus the time taken in signing his name, getting up from chair, crossing the room and sitting down, taking up a pen, etc., furnished a series of habitual reactions which the subject was unconsciously offering as a test and which were insusceptible of improvement on practice. They found a significant acceleration of performance under benzedrine, and a similar less pronounced effect with the closely allied drug isomyn.

Caffein has been shown to have a stimulating action on colour sensitivity and on certain psychomotor performances. Holck, Thornton and Smith (1939) found that caffein benzoate in doses of 300 mgm. produced an acceleration of tapping times and speed of reaction, together with an increase of the handgrip, whilst unsteadiness was also increased. Kravkov (1939) obtained a 40 per cent. increase in colour sensitivity to reddish orange and green after administration of 100 mgm. caffein.

Alcohol.—Mead (1939) found that 30 c.c. of pure ethyl alcohol administered in 150 c.c. of water decreased the percentage improvement in an artificial language test, but had no effect on a conditioned finger withdrawal test.

Barbiturates.—Robinson (1939) claims that tolerance to barbiturates is easily established, the patients requiring larger and larger doses, which may eventually lead to clinical evidence of toxicity. He has observed cases of barbital psychosis. Hambourger (1940), in an analysis of hospital cases, found that barbiturates accounted for more than 10 per cent. of the drug addicts, excluding alcoholics.

Tobacco.—Johnson and Short (1939) have investigated the reactions of the human body to epinephrin and tobacco smoke. They find a parallelism that they regard as furnishing evidence in favour of the view that toxic reaction to tobacco smoke is occasioned by an increased output of adrenalin.

Pain.—Goodell, Hardy and Wolff (1940) investigated pain sensibility by focusing the light from a 1,000 watt lamp on to a blackened area of the forehead 3·5 sq. cm. in area. The intensity of the radiation was measured by substituting a radiometer for the skin area. With this method they found that the pain threshold remained surprisingly constant for over a year. Heat and pain were differentiated by the action of acetosalicylic acid, which raised the threshold for pain and lowered it for heat. The peripheral end-organs for pain were found to be unaffected by ischaemia, whilst the thermal sense was abolished. Together with Schumacher (1940) these workers were able to show by their method that differences in the reaction of individuals to pain are not the result of individual variations in the pain threshold, but express the characteristic individual response. The reaction to pain at different times of the day may vary greatly while the threshold remains constant. Goodell, Hardy and Wolff (1940) showed that the pain threshold-raising power of morphia can be reduced or obliterated by severe pain experimentally produced before the administrations of the morphia, and a similar reduction could be effected by the previous administration of adrenalin. In spite of this reduction of the power of the drug to raise the threshold of pain, they find that the emotional reaction may still be markedly subdued. Lewis (1938) has drawn attention to the possibility of educating patients by the use of simple stimuli to differentiate

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clearly pain from skin, muscle, finger, tendon and periosteum, and to contrast such pain with that originating in deep structures. He points out that information from a patient so educated may greatly facilitate diagnosis. In a review of experimental studies on headache Wolff (1939) concludes that distension of the cranial arteries produces headache, and that the headache of migraine arises almost always from distension of the branches of the external carotid. Kunkle, Ray and Wolff have contributed an important study on headache, in which they point out that increased intracranial pressure is neither a prime nor an essential factor in the production of headache, which results from traction on or displacement of pain-sensitive intracranial vascular structure and is independent of pure generalizing intracranial pressure changes.

Achelis (1939) instances a number of observations which appear to form a summation theory of pain, and to be incompatible with the specification of pain-mediating systems, whether from the anatomical or the functional point of view. Thus in a hyperalgesic zone pressure spots disappeared; he suggests their conversion to pain spots. On the other hand, if appropriate methods of stimulation are employed it is possible to elicit pure tactile sensations from the cornea—an area which has been supposed to be supplied with exclusively pain-mediating nerve-endings. Rowbotham comes to a similar conclusion.

Tickle and itching.—Chordotomy causes a loss of tickle sensation on the analgesic side though tactile sensation is unimpaired. After chordotomy itching may be lost as well as tickle sensibility in the affected area. Bickford (1939), using histamine puncture, provoked spontaneous itching at the point of puncture, accompanied by a gradually developing change in the surrounding skin, which is evidenced by the appearance of a generalized itching sensation. A certain degree of asphyxia will abolish the itching skin, whilst leaving spontaneous itching unaffected. This is held to indicate different nervous mechanisms for the two conditions.

The phenomenon of tickle vanishes with anaesthesia *pari passu* with the itching skin. Some evidence is advanced that itching skin and possibly tickle is moderated by axon reflexes in a plexiform arrangement of nerve fibres.

Vasomotor responses.—Mittelmann and Wolff (1939), using the Hardy radiometer, made a number of observations on 47 subjects. In all but two subjects a drop in the temperature of the skin of the finger occurred under emotional stress. Affective states were induced by a discussion dwelling on difficulties affecting the subject's life to which he reacted with signs of emotion. The physical environment was, of course, controlled as to temperature and humidity and the relaxed subject was lying lightly covered, and during the control period the skin temperature remained fairly constant between 31° and 36° C. When an affective state was aroused the temperature of the fingers occasionally fell below room temperature.

Self-regulation.—By self-regulation is meant the phenomenon of self-regulation by the organism of its intake, so as to balance deficiency caused either by the absence of certain constituents in the diet or their defective metabolism. It may be objected that this subject is not one that can logically be included under physiological psychology, insomuch as the teleological orientation is not found to be conscious. On the other hand, a knowledge of the causation of this

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behaviour type is not only important as a contribution to the physiology of metabolism, but from it one may legitimately hope to learn something of the conditioning of other desires and repulsions.

An excellent review of our present knowledge of this subject is contributed by Richter to vol. iv of the *Annual Review of Physiology*. The review deals with papers published on instances of self-regulating activity in connection with the nutritive functions and the neurological mechanisms involved, with instances in which the self-regulating mechanism breaks down. Among some of the very interesting points made are the following: The evidence to hand indicates that the self-regulating process in role depends largely on taste and not on other forms of experience. After section of the taste-nerves adrenalectomized rats failed to differentiate between sodium chloride solution and water. Rats accepted or refused solutions of electrolytes according to their dietary value in extraordinarily low concentrations to which normal rats showed no preferences. Reference is made to the work of Bornstein (1940), who has concerned himself with a review of our knowledge regarding thalamic and cortical gustatory systems, and he concludes that the functional relations which taste bears to smell predicate a convergence in the cortex of these two kinds of sensations rather than separate taste and smell systems. These studies on self regulation indicate that the effort to maintain a constant internal environment constitutes a fundamental behaviour drive. The self selection technique gives us a method of determining chemical and metabolic needs that could only be discovered by biochemical methods after prolonged experimentation. Instances of clinically observed markedly unusual behaviour may often be considered to be manifestations of efforts on the part of the patient to maintain his internal environment. Thus, of course, polydipsia in diabetes insipidus is an effort to compensate for an increased loss of water.

Emotion.—According to Spiegel, Miller and Oppenheimer (1940), the rage reactions appear to be lodged in dogs and cats in the olfactory tubercle, the amygdaloid nucleus and the hippocampus fornix system. Bilateral lesions of these structures left the animal susceptible to outbursts of rage, while lesions of the neocortex failed to produce this reaction. Destruction of the olfactory bulbs was, however, without effect on the animals' behaviour, and Wolff (1939) removed the neocortex from three cats, avoiding damage to the olfactory system. Though these cats were active they never showed any signs of rage when handled. Masserman (1943) has subjected the whole question of the hypothalamus as a centre for emotion to a critical and experimental review. He concludes that animal experimental work on the hypothalamus may possibly reinforce the effector neural responses controlling some of the sympathetic and motor manifestations of fear and rage; there is little or no basis for the thesis that the hypothalamus governs or even mediates the motor experiences themselves. He points out that in man symbolization has to a large extent replaced more visceral methods of expression, and this fact alone may explain the paucity of reported cases of "sham rage" in human beings.

Grinker (1939), on the strength of his oscillographic records of the potentials resulting from hypothalamic stimulation in the human, together with the emotional results of such stimulation, supports the view "that anatomical or

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functional lesions in the hypothalamus may cause complete or partial release of cortical (ideational) control of the emotional content of higher activities. The dominant external activity would then be not a slow adaptive response produced by a process of long circuiting, but a less deliberate (impulsive) response with accompanying vasomotor correlates of emotional reactions."

Sleep.—Ranson has called attention to an interpretation of the function of the hypothalamus that should have been sufficiently obvious in that the so-called sleep centre is in reality a centre for maintaining the condition of wakefulness. Bilateral destruction of the hypothalamic area in monkeys was followed by profound somnolence. In view of the fact that descending tracts from the sympathetic nuclei of the hypothalamus traverse this area, it might appear that somnolence may be attributed to the elimination of the normal discharge from the hypothalamic centres. Harrison (1940) has substantiated the views of Ingram, Barres and Ranson by effecting bilateral lesions in the hypothalamus of cats and monkeys. Succeeding the lesion the animals present for a number of days an appearance of catalepsy and acute somnolence. In those animals surviving the lesion the somnolent condition gradually disappears, leaving the animals much more tractable and unemotional. In wild Rhesus monkeys bilateral extirpation of the mammillary bodies causes the animal to become friendly and tame. Serota (1939) measured the thermal relations of various areas of the cat's brain by thermo-electric couples. He found that in both the conscious and the anaesthetized animal the basal region was warmer than the cortex. When emotional states were induced, such as fear or rage or anticipation of food, the temperature of the hypothalamus increased. During sleep the hypothalamic temperature sank, and rose again on awakening, earlier, and to a greater relative degree than that of the cortex, the caudate nucleus or the cornu Ammonis. These changes were not thought to be due to increased blood flow such as Gibbs has recorded in active cortical areas, but to increased metabolism.

Nygard (1939) recorded the brain volume with a tambour over the skull opening of patients who had undergone temporal decompression. He confirms previous work in finding an increased brain volume during sleep, which is accompanied by slowing of the heart-beat and slight decrease of blood pressure. It was found that all these circulatory changes actually preceded the onset of sleep. Schnedorf and Ivy (1939) have revived the now generally discarded hypnotoxic theory of sleep. They withdrew 8 c.c. of cerebrospinal fluid from a normal dog and replaced it by an equal amount from dogs kept awake 7–16 days. The reaction is said to have been the induction of sleep or a sleepy state in the normal dog. It is obvious that without further chemical and physiological data these findings cannot be accepted as direct evidence of a hypnotoxic explanation of sleep.

Sexual behaviour.—Apart from the mass of endocrinological evidence which will be considered under the appropriate heading, there is some recent experimental evidence throwing light on the relations of the central nervous system to sexual behaviour. The observations of Brooks (1940) support the theory of the neurogenic control of the gonadotropic hormone in relation to ovulation. Not only does he confirm the observation of Westman and Jacobsohn that

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ovulation in the rabbit is absent after coitus in animals whose pituitary stalk is sectioned, but he observes that rabbits with the transected stalk fail to show any alteration in the amount of luteinizing hormone in the anterior hypophysis after mating, whereas it decreases regularly in unoperated control animals. Westman showed that when the excitability of the brain is abolished by novocaine, ovulation is temporarily suppressed provided that novocaine is injected intracisternally a few minutes after copulation. If it is injected later ovulation occurs (Gellhorn, 1942).

These and similar observations are, of interest in the study of sexual psychology in that they suggest that abnormalities of sexual conduct may be neurologically conditioned, and that the endocrine influence may occasionally be a secondary factor. Brookhart and Dey (1941) found that male guinea-pigs subjected to hypothalamic lesions show either a greatly reduced or no sexual activity, although spermatogenesis continues and the sexual vesicles remain intact. Papanicolau and Seward (1939) produced proof that hormones may act directly on the central nervous system by inducing oestrus after double hysterectomy when oestrin is injected. The experiments of Dempsey and Rioch (1939) show that sexual behaviour in the female guinea-pig is controlled by a centre located caudal to the anterior margin of the mammillary bodies and rostral to the intercollicular level. They bring evidence to show that the site of action of both oestrone and progesterone is in this area. Further experiments localized an afferent pathway for sexual impulses in the posterior columns of the spinal cord which decussates below the posterior corpora quadrigemina and runs through to the roof of the mesencephalon. They further showed that normal mating behaviour was not abolished by brain lesions in the septal and preoptic regions or after section of the pituitary stalk.

Cortical function.—Little has been added to our knowledge of cortical localization of function during the years under review.

The frontal lobes.—The results of prefrontal leucotomy as a method of treatment of certain psychoses are discussed elsewhere. They have naturally stimulated renewed interest in the function of the prefrontal area. Rylander (1939) undertook a detailed investigation of a number of cases of unilateral frontal lobectomy, and on the basis of 32 cases and an equal number of controls he considered that it was possible to give some quantitative expression of the degree of mental defect caused by the lobectomy. Thirty of the 32 patients showed a mental condition after operation which was markedly different from that presented before the onset of the pathological condition necessitating the surgical procedure. The two exceptions were a case of a cyst and of an abscess. In both of these cases there had been no mental disturbance before coming to the operation. Only cases in which the operation had been successful in removing the tumour were considered. The patients were observed for months and in some instances years after the operation. Changes both in emotional tone and loss of emotional control were the most common symptoms noticed. Euphoria and loquacity were present in 20 cases. There was a general loss of shyness, perversity and compulsion states in a number of the patients. Rylander found that all patients of pyknic habitus and syntonic personality reacted with euphoria, while those who were definitely leptosome and schizoid showed

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some degree of depression. Mixed types of physique showed a corresponding mixture of affective tone. Lack of tact and consideration for the feelings of others was one of the commonest syndromes. Twelve patients showed impairment of initiative, of which they were themselves fully aware. Rylander agrees with Brickner and Goldstein (1940) in considering that the power of abstract thinking is affected. No difference between the results from right or left frontal lobectomy could be ascertained. Stookey, Scarff and Teitelbaum (1941) report a series of 23 cases of unilateral frontal lobectomy in which the intelligence was tested after operation. They report that " when the lesion was completely removed little or no impairment of intellectual function resulted; emotional and social adjustments were satisfactory, and there was no loss of inhibition or spatial orientation." It may be summarily stated that all the evidence so far adduced in the period under consideration is in favour of Jefferson's original conclusion that if no marked symptoms are present before operation, none are to be detected after unilateral frontal lobectomy.

Bifrontal lobectomy is necessarily an uncommon operation, but should afford unequivocal evidence as to the functions of the premotor area. Brickner has published a follow-up investigation of his famous case of bilateral lobectomy performed by Dandy in 1930. He believes that lack of control over emotion is the dominant symptom. The patient is alternately boastful, angry, aggressive, negativistic, etc. In the intellect there is some degree of impairment of the power of synthesis and analysis. Slowness and rigidity of thought is accompanied by lack of insight, and the patient attempts to mask his defective comprehension by facetiousness and gross humour.

The operation of prefrontal leucotomy is discussed elsewhere. Most of the evidence summarized in the monograph of Freeman and Watts and the recent papers by Hutton, Fleming *et alii* point to a diminution of self-consciousness without intellectual impairment in those cases where no dementia had manifested itself before the operation. The latest cortical area phylogenetically to develop, it is perhaps not unreasonable to think that the prefrontal area subserves the last acquired mental process of self-consciousness. Brickner (1940) has recently made an addition to our knowledge of the functions of the frontal lobes by the discovery of an area of the frontal cortex, stimulation of which causes repetition. This is area 6 on the mesial side of the left hemisphere just above the junction of that area with the posterior part of area 32. A patient who was operated on under local anaesthesia was instructed to repeat the alphabet; when the stimulus was applied the patient stopped his sequence of letters at the letter which was being enunciated at that moment, and proceeded to repeat that particular letter again and again for such time as the stimulus lasted. As soon as the stimulus was removed he resumed his alphabet recitation. It is difficult to formulate any hypothesis as to the nature of the neural events underlying this phenomenon. It is to be hoped that a more psychologically directed analysis of the patient's experience during the period of perseveration will throw light on this problem when the experiment is repeated. It is, of course, highly desirable to ascertain whether the perseveration is confined to verbal action, or may manifest itself during any other sequence of movements.

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Temporal lobes.—The ablation of the temporal lobes has taught little as to their function from the point of view of the psychologist. Klüver and Bury (1939) performed bilateral temporal lobectomy on the monkey; they noted psychic blunders and unintelligent reaction to environment stimuli. There was some evidence of a loss or diminution of fear and anger responses and of the occurrence of hypersexuality. There were no major sensory or motor disturbances. After adequate training the animals were able to exercise simple visual discrimination. No other operation procedures gave rise to the same syndrome except complete interruption of the occipito-temporal communications. Hebb (1939), after extirpation of the right temporal lobe in men, noted an impairment of abstract thinking, though the patient remained alert and responsive.

Corpus callosum.—The tentative treatment of some cases of epilepsy by section of the corpus callosum in the hope that the discharge might be thereby rendered unilateral has given an opportunity to learn something of the mechanism responsible for the co-ordination of the cerebral hemispheres. Previous evidence on this subject had been complicated by the fact that all cases reported as having had section of the corpus callosum performed were suffering from gross lesions of the central nervous system. In a number of cases suffering from idiopathic epilepsy without any symptom indicating the existence of a gross cerebral lesion, the operation of division of the corpus callosum was performed by Van Wagener and Herring (1940), and the psychological state of the operated patients was investigated by Akelaitis and Parsons (1942). Neither apraxia or astereognosis was noted in any instance. Personality changes were not noted more frequently than in patients in general who undergo serious operations in the hope of relief from seizures. Speech records showed no variation from the normal in tone, pitch or other qualities. Studies of visual fields made when the splenium was divided showed no alterations. Such patients do not exhibit the temporary confusion noted after bilateral prefrontal leucotomy. None of these statements are true of patients who had a pre-existing compensated lesion of one hemisphere. In such cases a confusional state may be produced. It cannot be claimed that these observations have fulfilled such expectations as might have been entertained of arriving at some understanding of the function of the corpus callosum in the normal individual. It may be suggested that if reaction time experiments are performed on any future cases both before and after operation, disturbance of the reaction time for bilateral movements is likely to be found.

Mental Imagery.

During the past year an investigation of the physiological concomitants to mental imagery has been undertaken, checking the old respiratory observations of Golla and Antonovitch by electro-encephalography.

Golla, Hutton and Walter (1943) claim that by correlating the respiratory tracings with the evidence obtained from electro-encephalography and the patient's introspective account of his imagery, it is possible to show that the habitual type of imagery can be recognized from an inspection of the electro-

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encephalogram, and thus for the first time it has been possible to correlate variations of cortical potentials with mental processes.

Experimental Neuroses.

The production of experimental neurosis in animals has lately, it is claimed, thrown much light on a certain type of abnormal behaviour.

Such experiments must necessarily prove of great interest to students of physiological psychology. Masserman (1943) publishes a monograph giving a detailed description and analysis of the experimental results for 212 animals for a period of over seven years. On the strength of his experiments he formulates fundamental principles of animal behaviour:

1. Behaviour is motivated by the biological needs of the organism.

2. Behaviour is contingent on, and adaptive to, the meanings of the "objective" and "social" environment as interpreted by the individual organism.

3. Behaviour relieves bodily tensions not only by direct, but also by substitutive or symbolic activity.

4. When psychobiological motivations or environmental meanings become excessively confused or conflictual, behaviour likewise becomes abnormally substitutive, symbolic and biologically inefficient, that is, neurotic or psychotic in character.

It may be doubted if the foregoing propositions represent in any degree the fruits of so much prolonged and patient work with this particular method, which at first sight appeared promising.

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ELECTRO-ENCEPHALOGRAPHY.

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The history of electro-encephalography contains both triumphs and disappointments. The most profound of the disappointments is the relative failure to elucidate any of the important problems which concern the psychiatrist. It was hoped that some real electro-physiological alteration would be seen in patients whose mental condition suggested something bordering on the organic, but the negative findings even in the most profound mental disorders are almost as striking as if they were positive. Before considering the published work it would be well to review in a few words the nature and significance of electro-encephalographic records.

The fundamental axiom of electro-physiology is that all excitable tissue is capable of generating small electric currents, whose direction is such that the inside of the cell concerned is electro-negative to the outside world. This has been shown to be true for all nervous tissue, cortical neurones included, and it is therefore perfectly reasonable that the human cortex should produce electric currents of one sort or another. The size of these currents is, however, at no time very large, and when, as in the brain, the active tissue is surrounded by a majority of inactive cells and connective tissue, its feeble electric activity is dissipated in its immediate surroundings, and the amount of current or voltage remaining for the electro-physiologist is very minute indeed; moreover, in the case of the brain the intervening tissues of the head attenuate these currents still further, so that in order to detect the spontaneous electrical activity of the brain from the outside of the scalp, great amplification and sensitive recorders must be used. If the form and frequency of the brain potentials were such as are seen in the peripheral nervous system it is doubtful whether we should ever be able to study them at all. The typical nerve action potential lasts about $\frac{1}{1000}$ second and in normal conditions appears in volleys, sometimes synchronized, more often not, so that a record may often resemble closely the fundamental electrical "noise" which is the background to physical existence. The brain, however, does not appear to be so restricted in its behaviour; its electrical activity has large rhythmic components which stand out clearly against a background of jumbled action potentials and artefacts, like the note of a whistle above the murmur of a busy street.

It is because of this rhythmicity in its electrical behaviour that the electrophysiology of the brain can be studied at all without surgical aid, but it means also that we are liable to neglect potential changes which lack a rhythmic character, and in doing this we may be missing facts of the greatest importance. Electrical rhythmicity has an unfortunate physiological correlation; far from being action potentials, the electrical rhythms of the brain would be more truly described as "inaction" potentials, since they are seen most clearly

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when the part of the brain concerned is at rest. We are, therefore, constrained to studying what may be called the negative properties of the brain rather than its positive ones, which still elude us. The same condition applies in other fields, for it is easy to show by extirpation that a part of the brain had fulfilled some function, but it cannot be demonstrated by replacement that such function can be restored. An answer can be got by subtraction, but its accuracy cannot be checked by addition.

The significance of this situation in neuro-psychiatry is that the more subtle the disorder, the more slight the electro-encephalographic changes are likely to be, and the detection of minute and transient changes of rhythm is one of the most difficult tasks both for the standard apparatus and for the eye of the observer. This accounts for the contradictions and vacillations of opinion, which are the most prominent features of the literature. The earliest report on the electro-encephalogram in schizophrenia (Lemere, 1936) was that patients in this category showed less of the rhythmic alpha activity than normal patients. If this were true it would indicate an unusual degree of visual and mental activity—which is scarcely the most prominent feature of the schizophrenic condition. As a contrast it was claimed that manic-depressive patients showed an unusually large and regular alpha rhythm, suggesting an ability to disregard visual impressions and images, which again accords but ill with the conventional picture of the disorder. More lately a close resemblance has been claimed between schizophrenia and psycho-motor epilepsy on the basis of electro-encephalographic studies (Gibbs, Gibbs and Lennox, 1938). It is stated that—"On the basis of statistical, therapeutic and electrical evidence we believe that any relationship between epilepsy and schizophrenia is positive rather than negative. We believe that some of the clinical boundary lines which delimit different disorders characterized by recurring psychic or psychomotor symptoms are artificial, and are of secondary importance compared with classification based on physiological pathology." This bold and revolutionary belief, intriguing though it is, is contrary not only to the majority opinion of clinical observers, but also to most electro-encephalographic experience. In a later publication Gibbs (1942) amends the earlier claim and says "electro-encephalography cannot . . . at present be used to diagnose manic-depressive psychosis, schizophrenia, feeble-mindedness, migraine or psychoneurosis." More recently in a routine survey of mental hospital cases, Walter (1942) reported: "Definite abnormalities were found only among the epileptics, catatonic schizophrenics, cerebral atrophies, and in one case with an organic cerebral lesion. No true abnormalities were seen in non-catatonic schizophrenics nor in depressive conditions." From these few examples, which are representative of the whole literature, it is clear that no consistent or diagnostic features are found in the electro-encephalograms of psychiatric material.

This failure does not mean that the story is finished, however, but only that the easy successes in the first years of electro-encephalography have led to a certain impatience with anything but the most striking records. It is a fact which many observers have commented on after taking a few thousand records, that the eye becomes so practised in detecting the grosser abnormalities and

the more dramatic accompaniments of organic cerebral disease that it passes without question variations of a more subtle nature, and indeed the appetite for recording flags without the stimulus of an occasional "spike and wave" from a *petit-mal* or a focal delta rhythm from a cerebral tumour. All the more creditable therefore are the efforts of those who have attempted to reveal significant variations in the normal rhythm too slight for the unaided eye.

In one of her last papers Pauline Davis (1942) adopted a classification of records into three main types with the hope of obtaining some quantitative data on the relation between mental disorder and the normal features of the EEG. Her conclusions are too complex and technical to be summarized here, but the general impression is that some relationship may exist between the mental state and history of a patient and the fine structure of the EEG. Davis was not able to confirm the presence of slow or delta waves as a diagnostic feature in schizophrenic records. Her main contribution is the description given to certain records as "choppy," signifying apparently the presence of irregular higher frequency components in the record. This "choppy" activity was found in 61 per cent. of 126 schizophrenics as compared with 39 per cent. of 81 manic-depressives. Davis regards the "choppy" activity "as indicating primarily over-stimulation or irritation of the cortex which is due to unsynchronized activity within the central nervous system." She suggests that this "might account for apparent early deterioration in schizophrenics as a secondary effect of prolonged or continuous over-activity." In those of her patients under 40 years of age 47 per cent. of the schizophrenics but only 3 per cent. of the manic-depressives showed this "choppy" activity.

In collaboration with Sulzbach, Davis "demonstrated the occurrence of 'choppy' activity with the appearance of schizophrenic-like symptoms" during the administration of mescaline. Davis concludes that "the EEGs clearly demonstrate that the condition is *primarily* not one of physiological sluggishness."

These findings, though very suggestive, have unfortunately not been confirmed by other workers, and there is one important objection to the optimistic conclusions reached by Davis. This is the general one that components of the EEG having frequencies above 20 c/s are very difficult to distinguish from artefacts due to muscle action potentials, particularly with ink-recording oscillographs, which tend to smooth out higher frequencies or to convert them into small oscillations at the natural frequency of the recording pen. In a condition like schizophrenia, where disturbances of muscle tone are conspicuous enough to lead to a catatonic rigidity or flexibility, an unusual degree or quality of muscular activity is to be expected, even when its mechanical effects are not obvious, and it remains to be proved that Davis's "choppy" activity is not muscle action potentials.

A similar criticism has been made (MacMahon and Walter, 1938) of the reported delta waves in schizophrenics, which in most cases can be traced to artefacts due to ocular movements of the rhythmic type common in mental disorder.

It will be realized that this question of artefacts is of primary importance

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in recording from mental patients, and it is a matter which has received inadequate attention by many workers. Walter (1942) pointed out that the magnitude of potentials led off from the scalp depended, among other things, upon the electrical resistance of the brain itself and of the intervening tissues. Since quite gross changes are known to occur in the superficial tissues of schizophrenics (Hemphill, 1942), it is quite possible that some of the variations in voltage which have been described as characteristic of this condition may actually be due merely to variation in superficial electrical resistance.

Another attempt to "quantify" the EEG is that of Rubin (1938, 1939, 1940). He uses the conception of "per cent. time alpha" as a measure of the amount of alpha rhythm in a given record. This quantity is computed by measuring the percentage of two consecutive metres of record occupied by the alpha rhythm, which is taken to be at least three consecutive alpha waves. By recording from seven different points on the scalp in succession using an "indifferent" electrode on the mastoid process, Rubin was able to plot the *per cent. time alpha* against the position of his electrode, and he displays curves showing that the two hemispheres are symmetrical in normal people, but asymmetrical in certain cases with cerebral atrophy revealed by air replacement. Unfortunately another serious criticism can be made of this work. In his normal records Rubin demonstrates two peaks of *per cent. time alpha*, one in the parieto-occipital region and one in the frontal region. This would imply that alpha activity is as common in the frontal lobes as in the occipital, which is not the case. Simple experiment shows that when an "indifferent" electrode is placed on the mastoid process and another in the frontal region, the alpha rhythm will be picked up not by the frontal electrode, but by the mastoid one, which is of course nearer to the alpha focus than is the frontal electrode. That is to say, the "indifferent" electrode is not "indifferent" at all. Another criticism, not so serious, is that Rubin used ten-cycle filters "to make analysis easier." Since these filters would tend to produce a ten-cycle rhythm when receiving a transient or aperiodic input, the amount of alpha rhythm recorded would not necessarily be a true representation of the actual alpha activity. Yet another criticism can be made relating to a record in Rubin's paper showing a "psycho-motor seizure"; the transient potentials in this record are identical with those seen from eye movements, and it seems extremely probable that they are due to the rhythmic ocular tremor already referred to, particularly since his electrodes were on the forehead of the patient.

Since it would seem necessary to abandon hope that any specifically abnormal features are likely to be discovered in the EEGs of mental patients (compare Finley and Campbell, 1941), the physiological significance of the "normal" rhythms must be carefully considered. There is no doubt that the alpha rhythm itself contains much more of interest than was at first supposed. In the first place, since it is usually localized to the visual association areas of the cortex and may respond to both mental and visual stimuli, it must be considered one of the few direct methods of studying cortical physiology. It has been shown that the dominant frequency of the alpha rhythm correlates well with the basal metabolic rate, with the oxygen consumption of the brain and with the blood-sugar level (Lennox, Gibbs and Gibbs, 1938). There is an

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inverse correlation over a certain range with the CO_2 content of the jugular blood (Gibbs, Williams and Gibbs, 1940), and a rather irregular and puzzling relationship to intellectual level (Rahm and Williams, 1938).

Apart from these biochemical relationships, Jasper and Shagass (1941) have shown that the inhibition of the alpha rhythm by visual stimuli may be conditioned to previously inert stimuli, and that this conditioning obeys all the laws laid down by the Pavlov school. They remarked that this conditioning of the alpha response is one of the most satisfactory methods for studying the formation and function of conditioned reflexes in man, the limitations being only that the subject should happen to be one of those with a large and regular alpha rhythm.

The variation implied in the last paragraph is another of the important aspects of brain electro-physiology. In a recent paper Golla, Hutton and Walter (1943) have suggested that before any general statement can be made either about the alpha rhythm or the functions with which it is connected, the basic meaning of individual variations must be understood. As a preliminary classification they assumed that the EEGs of normal persons could be divided into three main groups: those with no appreciable alpha rhythm, even with the eyes shut and the mind at rest; those with an alpha rhythm only with the eyes shut and the mind at rest; and those with an alpha rhythm persisting even with the eyes open and the mind active. They found a correlation between the type of EEG and the type of habitual imagery used by the persons in solving mental problems. Those addicted to intense visual imagery tended to have the least alpha rhythm, and those unaccustomed to visual imagery were those in whom the alpha rhythm persisted. The responsive alpha subjects had mixed imagery.

The picture suggested by the brief outline above has great width and perspective, but the details are blurred and the true nature of the subject is still in doubt. Considering how poorly the simplest normal record is understood and how little has yet been done in connecting brain electro-physiology with character, mood and environment, it is scarcely surprising that disorders of the highest nervous function have proved so elusive and controversial: it may be in place here to mention that in their investigation of alpha types and imagery Golla, Hutton and Walter used a new method of record analysis. As was pointed out by Grass and Gibbs (1938), analysis of the electro-encephalogram into its component frequencies may be expected to yield information of a different order of importance from that obtained by ordinary methods. The ingenious analytical machine constructed by Grass performs such an analysis and has already given dramatic results. The Grass method, however, involves taking a special record on film and the analysis is not available for some time. In the method developed by Walter (1943*a* and *b*) a similar frequency analysis is performed automatically every ten seconds and the result of this is traced directly on the original record, so that the various components can be detected with a very short delay, and changes in the brain rhythms can be watched as conditions are varied and as the subject's mood changes.

The results obtained with this apparatus are already promising, but their relation to typical and individual variation is still to be worked out. One

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interesting point is that there is absolutely no correlation between physique and EEG type.

It is clear that sub-classification of " normal " records will be necessary and possible, and that correlation of the record with changes in the environment, both external and internal, will be essential before much further progress can be made.

This is particularly evident in studying cases of " psychopathic personality." Hill and Watterson (1942) found that in persons in this category who commit acts of violence the proportion of " abnormal " EEGs is unusually high. Harty, Gibbs and Gibbs (1942) consider the same to be true of psychopaths generally. The " abnormality " in such cases is, however, quite often an elusive one. This was dramatically illustrated by a case of matricide reported recently by Hill, Sargant and Heppenstall (1943). In this case the EEG showed little or no abnormality when the blood-sugar level was above 100 mgm. per 100 c.c., but when this was reduced to 80–90 mgm. per 100 c.c. various types of abnormality appeared—asymmetry of the two hemispheres, a 4–6 c/s rhythm in the right frontal lobe and a greatly increased sensitivity to hyperventilation. Such extreme variations with slight blood-sugar changes is in itself pathological or at least extremely unusual, and it is generally considered (e.g. Gibbs, 1942) that reduction of the blood-sugar level to 50 mgm. per 100 c.c. is necessary before a normal record begins to show any change. In the case of matricide, Hill, Sargant and Heppenstall were able to detect a change in consciousness during combined slight hypoglycaemia and alkalosis—a fact of forensic importance which contributed considerably to the evidence presented as to the state of mind of the accused at the time the murder was committed. Such extreme cases are probably rare, but slighter degrees of hypersensitivity or lability of the cortex are quite common, and in fact there is a smooth gradation in the normal range from the people whose record remains " normal " in extreme conditions of alkalosis and hypoglycaemia until consciousness is lost, down to those in whom a very slight change in biochemical conditions can precipitate an electrical crisis almost indistinguishable from a larval epileptic attack. It must be remembered that the clinical distinction between normal and abnormal persons often rests upon whether or not the person has sought medical advice. Fluctuations in mood and conscious control subjectively quite tolerable to one person may seem most sinister and morbid to another. It is perhaps adventuring beyond the formal bounds of electro-physiology and medicine, but this question of an individual's own concept of his affective and intellectual behaviour may come to play an important part in the detailed interpretation of neurophysiological data. Introspection is the least reliable method of human study, but introspective information, taken at its face value and compared with the physiological and physical realities, may complete a picture otherwise vaguely limned. An instance of this is the effect of low oxygen concentration upon the human subject, who has no complete physiological mechanism to compensate for a brief and sudden deprivation of oxygen. At low oxygen tensions there is often a feeling of combined lassitude and well-being, of indifference and confidence. The EEG shows that in this condition the brain is already abnormal, and that the gap between this state and a total lapse of

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consciousness is not wide, nor is the crossing of it attended by any subjective warning. Tolerance to low oxygen tensions and the symptoms associated with the state of strain vary greatly from one person to another. These variations are probably related to the EEG variations already mentioned, but those with the most labile EEGs are not always the first to exhibit loss of judgment and control.

Similarly there are epileptics with very frequent minor attacks who have learned to conceal and compensate for their frequent absences so well that their handicap is never detected by others, nor need they resort to medical aid until for some reason an EEG is taken and the characteristic waveform is revealed.

These simple examples point to a well-known but often conveniently forgotten axiom: The main feature of brain function is the enormous adaptability of its components. From the formation of a single conditioned reflex up to recovery from a hemiplegia, each element of the brain seems capable of a multitude of activities. Study of the number and interrelation of these activities is the basic problem of neurophysiology, and electro-encephalography is of unique importance only in so far as it contributes to that study.

A logical return to psychopathology may be made by way of childhood disorders. For some time the association between behaviour disorders and abnormal EEGs has been widely accepted. About 60 per cent. of "behaviour" cases give abnormal records, and of these a proportion—not agreed upon—are of the epileptic type. Electro-encephalography often reveals in children the presence of frequent minor attacks about which the child has never complained, accepting momentary blanks as a part of life. Similarly, epileptic equivalents, psychomotor attacks and occasionally post-epileptic automatism in children are occasionally the cause of inattentiveness in school, silly behaviour or even temper tantrums, all of which are complained of, not by the child, but by the teacher or parents. This state of self-ignorance may persist into adult life, accumulating neurotic features as the disability becomes more significant. The relation between the subjective appearance of such conditions and the type of EEG is an important subject for future study.

As well as the true epileptic records among behaviour problem cases, other types of abnormality have been described in such cases. The commonest is an unusual amount of activity in the 2–6 c/s band. In normal adults the amount of energy at these frequencies is very much smaller than in the 8–12 c/s alpha band, but in a proportion of "behaviour" children the energy in the lower frequencies is often higher than in the responsive alpha band. This would be a very significant observation if the EEG of normal children had been studied sufficiently. This is not the case, however; Hill has reported privately that in a group of normal children aged 14 to 17, 40 per cent. produced records of the low-frequency type, and that the response to voluntary hyperventilation was "abnormal" by adult criteria in the majority. This is similar to the observation of Brill *et al.* (1941), who also reported a significantly "higher" proportion of "abnormalities" among behaviour problem children.

In another communication Heppenstall and Hill (1943) stated that among head injury cases, more of those in whom the injury occurred in youth had

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abnormal EEGs than of those who were hurt in later years. This suggests that the immature cortex may be particularly sensitive to environmental changes, such as occur during hyperventilation and after injury, and that the slow rhythms so common in behaviour cases may be rather an exaggeration of an immature type of activity than a specific abnormal rhythm.

In Hill's cases the correlation of the EEG was better with what may be called "personality age" than with chronological or mental age, and the suggestion is that the essential *immaturity* of the aggressive psychopath and of the "behaviour" child with temper tantrums is associated with a real developmental failure in the nervous system.

The logical conclusion is that records of the non-specific slow-rhythm type should be classed as "immature" rather than abnormal, but the sub-classification of such records is very difficult without a quantitative analytic aid, and the future of this branch of the subject depends directly upon the technical developments in this direction.

From all the above contributions it will be seen that the EEG can offer no short cut to accurate diagnosis and prognosis in psychiatry. Often the clinical picture is complicated by the EEG result, and when attempts are made to combine electrical with psychological statements, profound confusion is usual. If psychology is a science, it is unique among sciences, since it embodies neither laws nor units; similarly, unless electro-encephalography is quantitative, it cannot claim to be more than a technical luxury. The lowest common multiple of the two subjects is higher than either separately, but it is rarely relevant.

Treatment.

The treatment of mental disorders has changed greatly in the last years, emphasis being laid on physical and physiological methods. Induced convulsions have been studied by several workers. Cook and Walter (1938), Rubin and Wall (1939) recorded during cardiazol seizures and published records showing the close electrical resemblance between these and spontaneous epileptic convulsions. Cook and Walter found that toward the end of the fit, slight muscular movements persisted when the EEG had become quite flat, while Rubin and Wall disagreed with this. The view of Cook and Walter was upheld by the experiments of Löwenbach and Lyman (1940) on electrically induced convulsions in the rabbit. The latter form of induction evokes discharges again identical with those of an essential epileptic fit (Golla, Walter and Fleming, 1940).

The EEG between convulsions has also been studied (Finley and Lesko, 1941). When treatment is given very frequently, a slow rhythm tends to persist and is correlated with some degree of mental confusion. This can be used to assess the frequency of treatment which a given patient can stand. The effect of induced convulsions upon the EEG is very variable, however. In one case of chronic schizophrenia who received 120 convulsions in the course of six months, the EEG remained entirely normal and the mental state unchanged, but in others only a few convulsions are necessary to evoke some degree of abnormality and confusion. This shows that the effect of induced

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convulsions must depend not only upon their number and frequency, but also upon the innate character of the patient's brain. The factor of age is also present—young patients are more likely to become confused and electrically abnormal than older ones. The question whether the temporarily abnormal EEGs sometimes found in convulsive therapy patients indicate some organic cerebral damage has not yet been answered. Smith, Hughes, Hastings and Alpers (1942) state that in cats "subjected to similar dosage" of electrical shock punctate haemorrhages are found in the brain, and there is a possibility that the transient effect of such haemorrhages is responsible for the EEG observations. The invariable disappearance of the mental and electrical disturbances is quite consistent with such an explanation, but does not demand it. The electrical dosage was relatively much higher in the animal experiments, and it is hard to decide what would be a truly equivalent condition to human electric convulsion therapy. There is no evidence that any serious damage results from induced convulsions, and the dearth of autopsy records, though it may tantalize the experimenter, satisfies the patients and confirms at least the safety of the method.

Löwenbach and Stainbrook (1942) have made the interesting suggestion that the prognosis is actually better in cases showing confusion after treatment, because, being less well orientated, they need help to find their bearings again, and this situation offers a very favourable opening for psychotherapy. If this is the case the EEG may be of considerable value in determining the correct moment to initiate psychotherapy.

The infantile regression in the Rorschach response after a convulsion, also reported by Löwenbach and Stainbrook, suggests that the EEG abnormalities may again be in the nature of "immaturities", rather than abnormalities. Speculation along these lines regarding the nature of mental disorder and reasons for the effectiveness of shock therapy are intriguing, but would lead to remote regions of metaphysics.

The action of other therapeutic agents, such as insulin and amytal, have been studied, but nothing relevant to psychiatric problems has emerged. Selection of treatment on the basis of patients' EEGs has been proposed by Lemere (1939), but this does not promise well, since the basic prediction is that violent methods such as convulsion therapy would make depressives and melancholics worse and schizophrenics better. The other suggestion, that those with slow rhythm records are less likely to benefit from convulsions, is more reasonable and is supported by experience (cf. Walter, 1942*a*).

A use of electro-encephalography so far little developed is for distinguishing hysterical and functional signs and symptoms from organic ones. Lundholm and Löwenbach (1942) find that the alpha rhythm in hypnosis and hysterical blindness behaves exactly as it does in normal people, that is, the *suggestion* of light and dark has no effect on the rhythm, whereas true light and dark have the usual effect. This is the opposite result from the original report of Loomis, Harvey and Hobart (1936), and agrees with the author's own findings (Walter, 1938). Similarly Lemere (1942) found no indication of insensitivity to light in hysterically blind patients, though the alpha rhythm was prominent when the eyes were closed. This indicates that the anaesthesia of hysteria is

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a disorder between the visual association areas and still higher centres of consciousness and perception. As a practical application, the blocking of the alpha rhythm by physical stimuli and mental alertness can be of definite value as a signal of responsiveness at the half-way house of central integration.

In conclusion, the contact between electro-physiology and mental medicine has been intermittent and sometimes harmful to both, but the value of the results has steadily risen. Reasonable optimism suggests that differentiation between neurosis, psychosis and organic disorders will be perfectly possible by electro-encephalography when the new techniques are perfected and combined with a rational understanding of the more subtle variations of biochemistry and personality. Investigations of this type are far more intricate than the mere inspection of a strip of record, and it is possible that the old enemy of the classroom, mathematics, may rear its hoary head. If scepticism is the obligation of a scientific worker, his privilege is to confound his unbelief.

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BIOCHEMISTRY OF THE NERVOUS SYSTEM.

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BIOCHEMICAL research has continued in spite of the war and considerable advances have been reported during the period under review. While the task of applying this new biochemical knowledge in the field of psychiatry has hardly yet begun, the underlying chemical mechanisms concerned in nervous activity are becoming considerably clearer and a few beginnings in this direction have been made.

The greatest advance in this field in the last few years has probably been in the elucidation of the phosphorylating mechanisms concerned in the metabolism of the brain. The recent isolation of a new phosphatide which is the chief component of cephalin marks a further advance in lipid biochemistry. In the present review an attempt has been made to report the main developments in the field rather than to review exhaustively every significant publication.

CARBOHYDRATE METABOLISM.

The chief fuel supplying the energy requirements of the brain is glucose. Three different things may happen to the glucose taken up from the blood by the brain: it may be (*a*) stored as glycogen, (*b*) glycolysed and eliminated from the brain as lactate, or (*c*) oxidized completely to carbon dioxide. In each case the first step is the phosphorylation of glucose to form glucose phosphate.

Phosphorylation of glucose.—When cell-free tissue extracts or homogenized brain tissue are incubated aerobically with glucose and inorganic phosphate, the glucose and phosphate disappear, and in the presence of fluoride phosphorylated products accumulate. These products include fructose diphosphate, which predominates, phosphoglyceric acid, and glucose-6-phosphate, which is believed to be the primary product (Colowick, Welch and Cori, 1940). Essential components of the system are (*a*) an oxidizable substrate, such as citrate, glutamate or succinate, (*b*) adenylic acid, (*c*) cozymase, and (*d*) magnesium ions. The adenylic acid acts as a phosphate carrier, while the oxidizable substrate is needed to provide energy for the reaction. Pyruvic acid can serve as an oxidizable substrate provided that a small amount of fumaric acid is also added. In the absence of fluoride, glucose is oxidized by brain dispersions and only small amounts of phosphorylated products accumulate.

The aerobic phosphorylation of glucose is important because it is the primary reaction in the utilization of glucose as a source of energy. The working out of the mechanism of this reaction shows how a phosphorylation may be coupled

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with an energy-producing oxidation reaction, and it illustrates the way in which oxidative energy is utilized in the cell.

Glycogen synthesis.—Cori and Cori (1940) have reported the synthesis of glycogen *in vitro* from glucose-1-phosphate by a purified enzyme phosphorylase from muscle, brain, heart and liver. Adenylic acid is required, and the activity of the phosphorylase is increased by the addition of glutathione. The reaction is reversible, the enzyme catalysing either the synthesis or the breakdown of glycogen; the position of the equilibrium is determined by the pH.

The synthesis of glycogen *in vitro* represents a big advance in carbohydrate biochemistry. It is of interest that the enzymes prepared from different tissues, though similar, are apparently not identical. Thus the phosphorylase from brain formed a polysaccharide giving with iodine the brown coloration typical of glycogen, while the muscle phosphorylase formed a product which gave with iodine a blue colour similar to that with starch.

The origin of the glucose-1-phosphate which is needed for the synthesis of glycogen was until recently a mystery, for the product isolated when glucose is phosphorylated directly is always the glucose-6-phosphate. Cori and his collaborators have now made this clear by showing that the enzyme phosphoglucomutase catalyses reversibly the interconversion of glucose-1- and glucose-6-phosphates (Sutherland, Colowick and Cori, 1941).

The enzyme phosphorylase which catalyses the synthesis of glycogen has been isolated as an adenylic acid complex in crystalline form (Green, Cori and Cori, 1942). The phosphoglucomutase was also separated from the other enzymes concerned in glycogen synthesis and breakdown. Glycogen has been isolated in the pure state from fresh brain (Kerr, 1938).

Glycolysis.—Brain has been considered by many investigators to be a tissue in which non-phosphorylating glycolysis occurs, but recent work has shown that it has probably a phosphorylating mechanism similar to that in muscle. Geiger (1940) showed that in concentrated extracts of brain an inhibitor is present which inhibits glycolysis, but this inhibitor is no longer active on dilution. The diluted extracts give a rapid lactic acid formation from glucose, mannose and fructose; they also form lactic acid from glycogen. The glycolysis will take place only in the presence of inorganic phosphate, adenosine triphosphate, cozymase and magnesium ions. In the presence of fluoride, phosphoglyceric acid accumulates; hexose diphosphate accumulates in the presence of iodoacetate. There is thus good evidence that glycolysis in brain may take a similar course to the Embden-Meyerhof scheme for muscle.

Ochoa (1941) found that hexose monophosphate and diphosphate are as readily glycolysed as glucose by cell-free preparations of brain. This again supports the view that glycolysis in brain proceeds by a phosphorylating mechanism.

Glucose and pyruvate oxidation.—The main path of carbohydrate breakdown is believed to occur through the oxidation of pyruvic acid. The formation of pyruvate from glucose is given by the Embden-Meyerhof scheme. In glycolysing cells pyruvate competes with oxygen as a hydrogen acceptor and is reduced to lactate, but in non-glycolysing cells pyruvate is oxidized to carbon dioxide.

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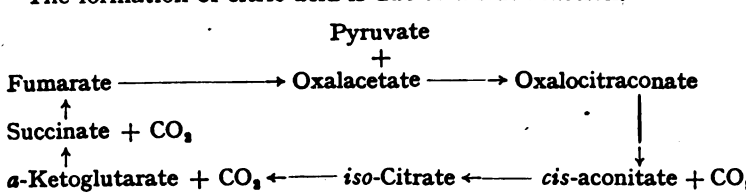
Pyruvic acid is able to react in a number of different ways, and Stern (1940) has tabulated 16 different possibilities of pyruvate utilization in the living cell; any one of these mechanisms might operate under suitable conditions, depending on such factors as the concentration of reactants, permeability factors, vitamin B_1 level and pH.

The decarboxylation of pyruvic acid to give acetaldehyde and carbon dioxide is catalysed by an enzyme that may be prepared from a variety of tissues, including muscle and brain (Green *et al.*, 1941). Carbon dioxide is evolved both anaerobically and aerobically. Under suitable conditions the acetaldehyde condenses with unchanged pyruvic acid to give acetylmethyl carbinol and a second molecule of carbon dioxide. The enzyme requires diphosphothiamin (phosphorylated vitamin B_1) and the presence of magnesium ions as coenzymes.

Particular interest has been taken in the last few years in the "citric acid cycle" of Krebs (1940); this gives a possible mechanism for the oxidation of pyruvic acid by a cyclical series of reactions involving the intermediary condensation of pyruvic acid with a C_4 dicarboxylic acid to give a C_7 acid, and subsequent oxidation of this C_7 acid in successive stages to give carbon dioxide with the regeneration of the original C_4 dicarboxylic acid again.

Wood *et al.* (1942) and Evans and Slotin (1941) have recently tested the citric acid cycle by the method of studying the fate of molecules which had been previously tagged with isotopic carbon (C^{13}). Their work showed conclusively that citrate cannot be an intermediary in the oxidation of pyruvic acid, and Wood *et al.* suggested a modified cycle which, with further modifications, has now been accepted by Krebs (1942). According to the present scheme pyruvate condenses with *enol*-oxalacetate to form oxalocitraconic acid; this is oxidized with loss of CO_2 to give successively *cis*-aconitate, isocitrate, *a*-ketoglutarate, succinate, fumarate, and finally *enol*-oxalacetate again. The formation of citric acid is due to a side-reaction.



Since citric acid is no longer included in the scheme it can no longer be called the "citric acid cycle" but no new name has hitherto been proposed.

The action of malonate, which inhibits the cycle at the succinate stage, can be used for testing whether the cycle is operating in any particular tissue. Banga *et al.* (1939) demonstrated the inhibition by malonate of pyruvate oxidation by dispersed brain tissue. This gave evidence that in brain, as in muscle and other tissues, a form of "citric acid cycle" may play a part in the oxidation of carbohydrate.

Pyruvate Metabolism and Vitamin B_1.

Recent work has confirmed the view that vitamin B_1 is concerned in the utilization of pyruvate in the living tissues. The phosphorylated product

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diphosphothiamin or cocarboxylase is probably the form in which the vitamin is effective. Guzman Barron *et al.* (1941) showed that the oxidation of *a*-keto-glutarate, a component of the " citric acid cycle " by avitaminotic tissues, is also accelerated by the addition of phosphorylated thiamin.

A variety of animal experiments have shown that thiamin deficiency causes an increase of pyruvic acid in the blood and urine; the pyruvate level is increased by increasing the carbohydrate intake in the diet. These experiments link up with the clinical observation of a raised pyruvate (or bisulphite binding substance) level in the blood in vitamin B_1 deficiency in man.

Bueding *et al.* (1942) found a slight but significant increase in the blood pyruvate of healthy, well nourished men within an hour after taking glucose. Vitamin B_1-deficient subjects had a higher resting level and showed a much higher rise after taking glucose. The resting pyruvate level was also raised in cases of " acute peripheral neuropathy." The apparent correlation between the blood pyruvate and thiamin has led to the idea of using the blood bisulphite binding substance (B.B.S.) as an index of vitamin B_1 deficiency; but Robinson *et al.* (1940) report that the B.B.S. is not consistently elevated in B_1 deficiency, and it may be normal in cases showing vitamin B_1 deficiency by clinical signs and by excretion tests. The B.B.S. elevation is less sensitive and less specific than the clinical tests already in use.

R. A. Peters (1940) and members of the Oxford school claim that the nervous symptoms in vitamin B_1 deficiency are directly due to the failure of the enzymes concerned in carbohydrate metabolism in the brain. This view has recently been challenged by workers at Cambridge (Banerji and Yudkin, 1942), who consider that the nervous symptoms are a secondary result of intoxication through the accumulation in the body of metabolic products associated with the defective or perverted carbohydrate metabolism. In support of their view they point out that the correlation between the metabolic defect and nervous symptoms is not precise; either may be present without the other. They have further succeeded in showing that rats will grow and thrive entirely free of symptoms on a vitamin B_1-free diet of fat and protein. Although the brain enzymes are defective, no nervous symptoms appear until they are given carbohydrate.

It has been generally considered that alcohol accelerates the onset of neuritic symptoms in alcoholic patients. Workers at the U.S. National Institute of Health have recently attempted to obtain further information on this point by means of animal experiments (Lowry *et al.*, 1942). Two series of rats were fed a thiamin-deficient diet and given either water or whisky *ad lib.* Contrary to expectations the neuropathy appeared in every case much earlier in the rats on water than in those on whisky. These experiments confirm the view that vitamin B_1 is not required in the utilization of alcohol.

Carbohydrate Utilization by the Brain.

Gibbs *et al.* (1942) have reported a valuable series of analyses of the chemical constituents of arterial and internal jugular vein blood in 50 normal male subjects. Their experiments confirm the high metabolic activity of the brain. From the oxygen uptake and glucose consumption they calculate that glucose

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is the principal source of energy, but the glucose is not all oxidized; some of it is converted into lactic acid. New experiments of Wortis (1941) have confirmed the view that the utilization of lactate by the brain is at the most very small. They found that the injection of lactate into hypoglycaemic patients during insulin coma caused only a slight increase in the oxygen consumption of the brain and, unlike glucose, it did not support the brain oxidations sufficiently to rouse the patients from their coma. Injected lactate did not prevent or alleviate insulin convulsions in seven hepatectomized dogs.

A number of investigators have obtained evidence of abnormalities in the carbohydrate metabolism in different types of mental disease. Lennox *et al.* (1940) measured the oxygen uptake by the brain and the glucose utilization in 18 patients with *petit mal*. They found that the ratio of the glucose used to the oxygen uptake was 1·08 for the patients with *petit mal*, and 1·48 for normal individuals. This suggested that the glucose metabolism is abnormal in the brains of patients with *petit mal*. Abnormalities in the carbohydrate metabolism have also been reported in mongoloid idiots (Himwich and Fazekas, 1940).

Lipid Metabolism.

Phospholipids.—The phospholipids are generally classified under three main molecular types: the lecithins, the cephalins and the sphingomyelins. In view of their physical properties the usual criteria of chemical purity are difficult to apply to these compounds, and their separation has always been a problem of some difficulty.

Folch (1942) has recently shown that the "cephalin" of brain can be separated into three fractions which exhibit different solubilities in chloroform alcohol mixtures: fraction (*a*) has the composition formerly attributed to the whole cephalin and may be called *phosphatidyl ethanolamine*, fraction (*b*) contains serine and is *phosphatidyl serine*, and fraction (*c*) is a mixture of phospholipids, one or more of which contain inositol as a constituent.

Phosphatidyl serine and the inositol-containing fraction are much more acidic in character than phosphatidyl ethanolamine and they are isolated from brain as their potassium or sodium salts. Treatment with acid removes the alkali cations. Both the amino and the carboxyl groups of the serine component of the phosphatidyl serine molecule are free. This new phosphatide comprises between 40 and 70 per cent. of the cephalin fraction of cattle brain. In view of this discovery much of the older work on cephalin will need to be reconsidered, and it offers possibilities for new work of greater precision in this field.

Glycolipids.—Klenk (1941) has isolated a new lipid with a high sugar content from the brain of a case of Tay-Sachs' disease. It was obtained also from normal brain in a yield corresponding to 10 to 14 per cent. of the total cerebrosides. This glycolipid yielded on hydrolysis 23·6 per cent. galactose in addition to phosphate, stearic acid, sphingosine, and a new unstable amino-acid which was designated neuraminic acid.

Lipid synthesis and turnover.—A new approach to the study of lipid metabolism has been made by the method of administering organic compounds

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which have been "tagged" by incorporating into the molecule heavy hydrogen (deuterium), isotopic carbon (C^{13}), heavy nitrogen (N^{15}), or radio-active phosphorus (P^{32}).

These new methods have enabled the classical view of the relative stability of the lipids of the brain to be confirmed with greater certainty; but they have shown that the old distinction between the metabolic and the non-metabolic or fixed lipids of the tissues can no longer be sharply maintained.

Sperry and his collaborators (1941) used the method of feeding linseed oil which has been labelled by partial reduction with deuterium. They found that appreciable amounts of deuterated lipid appeared in the liver, intestine and depot fats after feeding to rats, but only traces could be isolated from the brain. In the course of a week 20 per cent. of the fatty acids of the brain were replaced. During myelination the unsaponifiable lipids and fatty acids were rapidly replaced in young rats 15 to 19 days old. They concluded from their experiments that growth is more important than myelination in affecting the rate of deposition of brain lipids.

Hevesy and Hahn (1940) and others have taken the investigation a step further by following the rate of assimilation of radio-active phosphorus into the different lecithin, cephalin and sphingomyelin fractions. Fries and Chaikoff (1941) studied the rate of deposition of radio-active phosphorus in various parts of the brain in rats of various age groups.

An important application of the radioactive indicator technique is the demonstration with P^{32} of the synthesis of phospholipids by excised nerve and brain slices *in vitro*. The synthesis of phospholipid requires the presence of oxygen, and it is accelerated by glucose but not by pentose; it is inhibited by cyanide and other respiratory inhibitors (Fries, Schachner and Chaikoff, 1942). These experiments show that the phospholipids of brain and nerve are synthesized in the tissues themselves and are not derived from the plasma.

Distribution of lipids in the brain.—Figures giving the distribution of lipids, cholesterol and other compounds in different parts of the brain have been given by Randall (1938). Differences in the lipid content of the brains of male, female, castrate and ovariectomized rats were observed by Weil (1941).

Nitrogen Metabolism.

Gjessing (1939) has continued his outstanding work on the nitrogen metabolism in periodic catatonia, and further cases have been reported by Hardwick and Stokes (1941) in which phasic changes in the mental state are associated with phasic changes in the nitrogen excretion. They observed in one case that increasing or diminishing the protein in the diet did not disturb the rhythm of the mental disorder. They concluded that the variation in nitrogen excretion is not secondary to the mental disturbance, nor is the mental disturbance immediately caused by the specific metabolic change. Both the metabolic and the mental changes may result from a primary cyclical change in the endocrine balance.

Greving (1941) carried out serial metabolic studies in which he compared two schizophrenics with two recovered schizophrenics maintained under the same conditions. Metabolic disturbances characterized by nitrogen retention,

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disturbed urea synthesis and impaired cholesterol esterification preceded the phases of mental disturbance.

Gildea *et al.* (1940) have estimated the serum protein, non-protein nitrogen and lipids in the blood of patients with schizophrenic and manic-depressive psychoses. Gjessing adopted as a working hypothesis the view that a toxic substance, which may be an amine, is produced at the time of change in the nitrogen balance, and this has renewed interest in the question of toxic amines.

Amine inactivation.—The amine oxidase is the system mainly responsible for the detoxication of amines in the body; it is present chiefly in the liver, kidney and intestine, but smaller amounts are also present in other organs including the brain (Richter, 1938; Bhagvat *et al.*, 1939; Mann and Quastel, 1940). Bhagvat *et al.* (1939) have completed a study of the oxidation of 82 different amines by the amine oxidase and a good deal is now known about the specificity of the enzyme; it readily oxidizes most amines of the type $R–NH_2$, but it has no action on and is inhibited by isopropylamine derivatives, such as ephedrine and benzedrine. Most amines are rapidly inactivated in the body after administration by mouth; but amines such as ephedrine, mescaline, benzedrine and methylisomyn, which are not oxidized by the amine oxidase, have a much more prolonged action in the body and they are finally excreted unchanged in the urine (Richter, 1938). Phenolic amines such as epinine and corbasil are inactivated to a considerable extent by esterification (1940), and the body contains a special diamine oxidase which inactivates the diamines such as putrescine and cadaverine.

Mann and Quastel (1940) have shown that the inhibitory action of amines such as tyramine on glucose oxidation by brain slices is due in part to aldehydes, which are formed secondarily from the amines through oxidation by the amine oxidase. Benzedrine competes with other amines for the amine oxidase and it can thereby diminish the formation of aldehydes. They believe that the action of benzedrine *in vivo* may be linked with its ability to compete with amines giving rise in the body to toxic substances. The presence of such toxic substances under the conditions in which benzedrine acts *in vivo* has not, however, been demonstrated.

A sensitive method has been described for estimating amines in the blood. The method can be used to measure the rate of detoxication of *iso*-amylamine which has been injected intravenously, and this has been suggested as a test of the amine oxidase function (Richter, Lee and Hill, 1941).

The toxic amine hypothesis has been frequently considered in relation to mental disease. Our knowledge of the bodily mechanisms for inactivating toxic amines has greatly increased, but work on the clinical side has been almost entirely negative. There are considerable difficulties in applying the toxic amine hypothesis to Gjessing's data, since during the time of mental disturbance some patients are found to be in a state of positive nitrogen balance, while in others the nitrogen balance is negative. Further, the nitrogen retention observed in his cases applies to all the protein degradation products found in the urine, which suggests that the fundamental disturbance involves the whole protein catabolism, and not merely a single intermediate metabolite which might give rise to a toxic amine. Richter and Lee (1942), who have discussed

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the toxic amine hypothesis, found no evidence of the presence of toxic amines in the blood of 58 selected psychotics of various types, though there was a slight increase in the amino-lipid fraction in 18 schizophrenics. Pugh (1940) reported the absence of tyramine in the urine of 400 mentally defective patients. Indications have been obtained (Berkenau, 1940) of a disturbed liver function in certain types of catatonic schizophrenics, but there is no evidence that amine detoxication is specifically impaired in these patients.

Acetylcholine and Adrenaline.

Acetylcholine.—Loewi and Hellauer (1938) found that the ventral spinal roots and preganglionic sympathetic trunk are rich in acetylcholine, while the optic nerve contains little or none. Subsequent investigators have confirmed and extended the original observations by adding to the list of nerves that are rich and to those that are poor in acetylcholine. It is now possible to generalize by saying that the distribution of acetylcholine in the peripheral nervous system is the same as that of cholinergic fibres (motor and preganglionic sympathetic fibres), while sensory nerves contain practically none. Mixed nerves contain intermediate amounts, and post-ganglionic sympathetic nerves probably contain adrenaline (Lissak, 1939).

MacIntosh (1941) has extended the investigation into the central nervous system, where he has found again that the parts containing efferent fibres are rich in acetylcholine, while parts containing only afferent fibres have little or none. The cerebral cortex and certain nuclei and tracts in the brain are rich in acetylcholine, but other nuclei and tracts are relatively poor.

In view of these findings, Dale's biochemical classification of the peripheral nervous system into cholinergic, adrenergic and sensory components is no longer an indirect inference from pharmacological data, but an experimentally demonstrable fact. The exact function of acetylcholine is not yet clear, but the fact that nervous tissue can now be separated into different varieties differing in this way in chemical composition represents a considerable advance.

Further work by Mann *et al.* (1939) on the synthesis of acetylcholine by respiring brain slices *in vitro* has added to our knowledge of the conditions under which it may occur. Mann and Quastel (1940) have shown that although glucose accelerates the reaction, the synthesis of acetylcholine does not require the presence of thiamin, since there is no appreciable difference from normal in the synthesis of acetylcholine by brain slices from thiamin-deficient pigeons.

The work of Kahlson and MacIntosh (1939) on the perfused superior cervical ganglion is of particular interest in that it links up the biochemical work on acetylcholine synthesis with physiological work on the transmission of nervous impulses. They showed that the failure of the perfused ganglion to transmit impulses when fatigued by prolonged stimulation was paralleled by the decreasing ability of the ganglion to synthesize acetylcholine. The ganglion perfused with fluid containing only inorganic salts soon showed fatigue, while fatigue could be prevented by addition to the perfusion fluid of glucose, mannose, lactate or pyruvate. These substances also promote the synthesis of acetylcholine. Fructose, sucrose and other metabolites were ineffective.

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Choline esterase.—The choline esterase content of the human foetus increases in parallel with the development of the neuromuscular system (Youngstrom, 1941). In the sheep embryo the choline esterase activity is higher in the spinal cord than in the brain during the period of development of the activity of the spinal centres, but later the activity in the brain centres increases and it rises rapidly before birth (Nachmansohn, 1940).

The concentration of choline esterase is much higher in the head ganglion than in the giant nerve fibre of the squid; it is present mainly at the surface (Nachmansohn and Steinbach, 1942). These observations have been cited in favour of the view that choline esterase is concerned specifically with the processes involved in neural transmission. A number of observations have been reported on the serum choline esterase activity in nervous disease (Richter and Lee, 1942). High serum esterase activities have hitherto been found in (*a*) severe anxiety, (*b*) acute depressive states, (*c*) thyrotoxicosis, and (*d*) certain "post-concussional states," while low activities have been found in (*e*) catatonic stupor, (*f*) extreme debility, and (*g*) in narcosis. These observations suggest that the high serum choline esterase activity in emotional states and in thyrotoxicosis may be attributed to the increased autonomic activity or to the increased neuromuscular activity associated with these conditions. This conclusion is supported by the observation of Randall and Jellinek (1939) that the serum choline esterase activity in schizophrenics is increased significantly by "shock" therapy with insulin, since there is evidence that sympathetic activity is increased in "shock" therapy. Richter and Croft (1942) have recently found that the serum choline esterase activity is raised by as much as 50 per cent. by vigorous muscular exercise; here again a high choline esterase activity is associated with increased autonomic and neuromuscular activity.

Biochemical investigation has shown that the choline esterases form a group of enzymes which differ considerably in their individual properties (Richter and Croft, 1942). The serum choline esterase in man is not specific for choline esters, but also hydrolyses the aliphatic esters such as methyl butyrate and tributyrin.

Acetylcholine and nervous activity.—The precise role of acetylcholine in relation to nervous activity is still a matter of dispute. Some investigators believe that acetylcholine is the specific transmitter substance concerned in the transmission of nervous impulses at all myoneural junctions and at the synapses in the central as well as in the peripheral nervous system; other investigators are unwilling to consider acetylcholine as anything more than an incidental by-product of nerve metabolism.

The acetylcholine found in the tissues does not occur there for the most part in the free form, but in a bound form in which it is apparently combined with protein and therefore inaccessible to the action of choline esterase. Free acetylcholine is liberated from the bound form by the alcohol or acid used in extracting the tissue.

Lissak (1939) has confirmed that when a cholinergic nerve trunk is immersed in a bath of saline, electrical stimulation causes free acetylcholine to pass from the nerve trunk into the bathing fluid. While this experiment emphasizes the

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relation of acetylcholine to nervous activity, it suggests that acetylcholine is not concerned exclusively in the processes at the synapses or myoneural junctions. Acetylcholine has been reported to pass into the cerebrospinal fluid after stimulation of the afferent vagus or of the hypothalamus (Chang *et al.*, 1938), which again demonstrates that acetylcholine is concerned in nervous activity.

Clark and Raventós (1938) have made a careful study of the kinetics of inactivation of acetylcholine by choline esterase. They estimate that the time required for the inactivation of acetylcholine in muscle at concentrations below 10^{-6} is of the order of 20 to 40 seconds. No process has yet been demonstrated in any tissue that can effect the destruction of small amounts of acetylcholine in a few milliseconds, as would have to occur if acetylcholine mediated the transmission of nervous impulses at the sinapses.

Schweitzer *et al.* (1939) have attempted to obtain further evidence of the role of acetylcholine by studying the action of choline esterase inhibitors in the central nervous sytem. They found that of a large group of inhibitors some acted as central depressants while some showed excitatory action. The pharmacological action appeared to be a function of the lipid solubility of the anti-choline esterase; the central excitants were all lipid-soluble, while the depressant drugs were not. There was a close quantitative relationship between the anti-choline esterase activity *in vitro* and the action *in vivo*. While these observations support the view that acetylcholine plays a part in the central nervous system, the precise role of acetylcholine is still unknown. There can be no doubt that even at very great dilutions acetylcholine exerts a profound effect on the activity of certain types of cells. The views are widely held that acetylcholine may be concerned in the processes involved in the transmission of the nervous impulse along the nerve fibres, or that it acts primarily by modifying the responsiveness of the receptor to stimulation.

Adrenaline and sympathin.—Recent work has given further evidence of the identity of adrenaline and sympathin, the " transmitter substance " of the post-ganglionic sympathetic nerves. The output of sympathin obtained in the perfusion fluid on stimulating the sympathetic nerves to the perfused rabbit's ear can be greatly increased by the addition to the perfusion fluid of a small amount of ephedrine (Gaddum and Kwiatkowski, 1938). Ephedrine sensitizes a variety of structures, including the frog's heart and the nictitating membrane of the cat to the stimulating action of adrenergic nerves; it has the same sensitizing action on the stimulation by adrenaline.

Ephedrine inhibits the amine oxidase, which has been shown to oxidize adrenaline *in vitro*, and Gaddum has suggested that the pharmacological actions of ephedrine may be attributed to its inhibiting the amine oxidase *in vivo* and so preventing the destruction of adrenaline. This would explain the increased yield of sympathin from the rabbit's ear when ephedrine is added to the perfusion fluid, and the action of ephedrine in sensitizing structures such as the nictitating membrane to adrenaline action. According to this view the amine oxidase and ephedrine play a role corresponding to that of choline esterase and eserine. While this theory explains a great many of the facts, further work by Richter and Tingey (1939) has shown that there is no significant inhibition of the amine oxidase by ephedrine at the concentrations used by Gaddum.

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They conclude that it is unlikely that the amine oxidase is specially concerned in the inactivation of adrenaline.

The ease with which adrenaline is oxidized *in vitro* has led it to be supposed that adrenaline is also inactivated by oxidation *in vivo*. It has now been shown that after the administration of adrenaline a considerable part of the adrenaline is excreted in the urine in the form of an adrenaline ester (Richter, 1940). Richter and MacIntosh (1941) have found that the adrenaline ester is pharmacologically inactive when tested on the blood pressure, nictitating membrane and intestine of the cat. Chemical evidence indicates that the adrenaline ester is probably a sulphate ester, in which esterification has occurred at one of the phenolic hydroxyl groups. These experiments suggest that the "sulphosynthase" system, which is responsible for the synthesis of sulphate esters, may be the system mainly concerned in the inactivation of adrenaline *in vivo*.

Lissak (1939) has shown that adrenaline is not liberated exclusively at the nerve endings, but also from the nerve trunks of adrenergic nerves when they are electrically stimulated.

Mechanism of adrenaline action.—The biochemical mechanism of the action of adrenaline on plain muscle is still obscure; but in addition to this effect adrenaline also mediates the glycogen breakdown in emotional hyperglycaemia, and some information as to the chemical mechanism of this process has now been obtained. The glycogen breakdown in the liver has generally been attributed to an activation of the liver amylase by adrenaline. It has now been shown that adrenaline acts by increasing the rate of phosphorylation of glycogen (Lee and Richter, 1940). This is not due to a direct activation of the phosphorylase, but it may be due to a coupling of the phosphorylating system with the reducing systems of the cell, which results in the rapid phosphorylation of glycogen and the breakdown of the glucose-1-phosphate to give free glucose.

The action of adrenaline in producing the subjective sensations of anxiety has interested many investigators. Dynes and Tod (1940) observed that the emotional response is absent in deteriorated schizophrenics, although they show the physiological responses to adrenaline. Thorley (1942) has confirmed the view that patients with anxiety states are more sensitive to adrenaline than normal subjects, and he has shown that they give an increased physiological response as well as an increased emotional reaction.

Respiration in the Central Nervous System.

Effects of oxygen lack.—Resistance to oxygen lack is a problem of practical importance in wartime in connection with high altitude flying. Emotional control and judgment are impaired by relatively mild degrees of anoxia, and military flying is conducted up to altitudes (40,000 ft.) so high that anoxia may occur even when inhaling 100 per cent. oxygen. Barach *et al.* (1941) have found that resistance to oxygen lack is related to the basal metabolic rate and the resistance is greatly increased in thyroidectomized animals. They conclude also that the susceptibility of pilots to "pilot error" due to anoxia may be

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significantly increased by the mild carbon monoxide poisoning which results from cigarette smoking. In 18 inhaling smokers the arterial blood was found to have a mean carbon monoxide saturation of 5·7 per cent. after smoking 20 cigarettes between 9 a.m. and 4 p.m. Lyman *et al.* (1941) studied the effects of pseudo-ascents to high altitudes in a decompression chamber on the EEG. They observed periods of general flattening of the waves at pressures corresponding to 18,000 ft. in subjects who had removed their gas masks, but the changes were variable in constancy and degree.

The excitability of the cerebral cortex *in vivo* depends on the blood glucose level as well as on the oxygen tension. These two factors act synergistically, so that the effect of anoxia on the brain potentials is greatly aggravated by insulin hypoglycaemia (Gellhorn and Kessler, 1942), while the effect of hypoglycaemia can be offset by the inhalation of 100 per cent. oxygen. Anoxia and hypoglycaemia together depress the cortical potentials more than corresponds to the algebraic sum of the separate effects. While the somatic nervous system is depressed in anoxia, the sympathetic system is in a state of increased tonicity and excitability. There is a similar synergism between anoxia and hypoglycaemia in their effects on the sympathetic nervous system.

Hoagland *et al.* (1939) showed that thyroxin and dinitrophenol, which increase the basal metabolic rate, both accelerate α-wave frequencies, while factors such as hypoglycaemia and narcotics, which lower the metabolic rate, lower the frequencies. They conclude that the relative frequency of the cortical rhythms is determined basically by the respiratory rate of the cortical cells.

Respiration of the isolated neuron.—A considerable literature now exists on the gross respiration of the central nervous system, and evidence is accumulating on the respiration of structurally delimited regions. Pearce and Gerard (1942), in a publication that is of considerable interest, have now measured the respiratory intensity per neuron in various parts of the brain of the frog. The amounts of tissue used were of the order of 1 mgm., and the time elapsing between decapitation and commencement of respiratory measurement was as little as 10 minutes. The number of cells was measured by macerating the tissue and counting the cell nuclei in a homogeneous suspension in a solution containing acetic acid and gentian violet. The oxygen uptake per neuron varied from $9{\cdot}1 \times 10^{-6}$ cu. mm./hr. in the hippocampus to $1{\cdot}7 \times 10^{-6}$ in the cerebellum.

Nachmansohn and Steinbach (1942) have followed the lead of the electrophysiologists in utilizing the giant neurons of the squid to study the distribution of respiratory enzymes in different parts of the nerve cell. They found that the succinic dehydrogenase is concentrated in the axoplasm, which contains 90 per cent. of the total amount, and much less is present in the sheath. This is the reverse of the distribution of diphosphothiamin, which, like choline esterase, is concentrated mainly at the surface.

Intermediary oxidation systems.—The system chiefly concerned in oxidations by molecular oxygen in the brain is the cytochrome oxidase system. The dehydrogenases catalyse the transfer of hydrogen from the oxidizable metabolites of the cell to the cytochromes. The cytochrome oxidase then catalyses the oxidation of the cytochromes by molecular oxygen.

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The cytochrome oxidase was generally believed to be a copper-protein complex. Keilin and Hartree (1939) have now described a new iron-porphyrin-protein complex "cytochrome component a_3" which they believe to be identical with the cytochrome oxidase. The component a_3 is thermolabile and gives characteristic absorption bands. It combines with carbon monoxide and the other respiratory inhibitors. The new component a_3 is apparently identical with the "respiratory enzyme" of Warburg. Narcotics, such as urethane, inhibit the reduction of components, *a*, a_3 and *c* by the dehydrogenase systems; they also inhibit the oxidation of component *b*. Work on the individual properties of the different cytochromes is actively proceeding in several laboratories and the isolation of cytochrome *a* has now been reported.

Most of the work on the cytochromes has been done with muscle tissue, but in view of the close similarity between the metabolism of muscle and of nervous tissue it can hardly be doubted that these results are applicable to brain. The presence of the cytochromes and of cytochrome oxidase has been demonstrated in brain; both are present in high concentration in the grey matter of the cortex, but relatively deficient in nerve.

Oxidation and phosphate transfer.—During the last few years interest has been focused on the relationship between oxidation reactions and phosphate transfer. Reference has been made already to the coupled aerobic phosphorylation of glucose. Endothermic phosphorylation coupled with oxidation would appear to be one of the main mechanisms for the transfer of energy used by the cell.

Ochoa (1941) has studied the coupling of phosphorylation with the oxidation of pyruvate in pigeon brain preparations. The phosphorylation of adenylic acid could be inferred from the fact that addition of catalytic amounts enabled phosphate to be transferred to other substrates. At least two molecules of phosphate were transferred for each atom of oxygen consumed in oxidizing the pyruvate. Needham *et al.* (1941) have obtained evidence that a transfer of phosphate may occur from adenosine triphosphate to protein; this was indicated by physical changes that were observed in the myosin fraction of the proteins of muscle when adenosine triphosphate was added and thereby broken down. Adenosine triphosphate has recently been isolated from brain (Kerr, 1941), and it appears likely that here again there may be an analogy between muscle and brain metabolism. Mann and Quastel (1941) have studied the breakdown of diphosphopyridine nucleotide, an important constituent of the dehydrogenase systems, by suspensions of brain. They concluded that the breakdown is due to a nucleotidase, and they found that the addition of nicotinamide prevented the breakdown. Stone (1940) has published analyses of the inorganic phosphate, phosphocreatine, adenosine triphosphate and other phosphate fractions in brain.

Narcotics and Convulsants.

Further work has been reported by Michaelis and Quastel (1941) on the inhibition of respiratory processes by narcotics. Anaerobic glycolysis is not inhibited by chloretone, but the inhibition of the oxidation of glucose, lactate

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and pyruvate has been studied using brain slices or minced brain tissue. It is concluded that the inhibitory action of chloretone is due to its affecting either a flavoprotein or some component of the respiratory system intermediate between the flavoprotein and the cytochrome-oxidase. The point at which narcotics act has been discussed also by Keilin and Hartree (1939). Fuhrman *et al.* (1941) have criticized the view that narcosis is due specifically to an inhibition of glucose oxidation in the brain. They found that phenobarbital and 1 : 3-dimethylbutylethyl-barbiturate, which is closely similar to phenobarbital in structure, both inhibit the oxidation of glucose by brain slices; but whereas the one compound is a depressant, the other is an excitant and produces convulsions.

Stone (1938) has studied the lactic acid content of the brains of normal and of narcotized mice, which were killed by immersion in liquid air. The mean lactate concentration was greatly lowered by narcotization with phenobarbital, amytal and ether. The brain lactate was increased during exercise and greatly increased during convulsions induced by picrotoxin, metrazol and sodium cyanide. During insulin convulsions the brain lactate was lowered. It would be attractive to suppose that the brain lactate level gives an index of the degree of nervous activity, corresponding to the increased lactate level during activity in muscle; but against this view is the fact that during nicotine convulsions the brain lactate level remained unchanged. The lactate rise during cyanide convulsions was also much larger than with the other convulsants, which suggests that the lactate level is determined by factors other than the degree of nervous activity. Control experiments showed that the high brain lactate values cannot be attributed to diffusion of lactate from the blood to the brain. Brain phosphocreatine increases and inorganic phosphate decreases during barbiturate anaesthesia (Stone, 1940). Stone's results are some of the first reliable data that have been obtained hitherto on the intermediary metabolism of the brain during narcosis, exercise and convulsions.

A great many papers have appeared recently on the antagonisms between the various central excitants and central depressants. These drugs show considerable individual specificity in their effects on the different centres. Rosenthal (1941) has shown, for example, that picrotoxin hyperglycaemia is regularly suppressed by many hypnotics, such as the barbiturates, chloretone and paraldehyde, which depress the blood-sugar regulating centres; but urethane even in large doses cannot annul the hyperglycaemic action of picrotoxin. Depression of the sugar-regulating centres can be obtained independently of any action on the sleep centres.

Watterson and Macdonald (1939) have found that cardiazol convulsions are inhibited by the parasympathomimetic drugs carbaminoyl-choline and acetyl-β-methylcholine and by sodium cyanide. They attribute the inhibitory action to cerebral vasodilatation, which increases the rate of cerebral blood flow.

Putnam and Merritt (1941) have discussed the various chemical factors which may affect convulsions. Seizures may be excited in predisposed individuals by hypoglycaemia, oxygen deficiency, pH shift of the blood and by numerous drugs; they may be prevented by an excess of carbon dioxide,

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glucose, and in some cases of *grand mal* by anti-convulsants. A shift in the acidity of the milieu of the nerve cells may become a decisive factor in the production of convulsions. They suggest as a hypothesis of the mechanism of anti-convulsant action that the anti-convulsants enter the nerve cells *via* the lipid membranes and there break down to give stable aromatic acids.

The brain glycogen level falls after administering insulin, but convulsants such as strychnine, metrazol and picrotoxin do not lower the brain glycogen appreciably (Kerr and Antaki, 1938).

Mineral and Water Metabolism.

Improvements in the technique of measuring the plasma, lymph and extracellular fluid volumes have been discussed in a recent review of the literature on water metabolism by Peters (1942). The use of the Evans blue dye is a considerable improvement on the older methods for measuring the plasma volume.

Use has been made of radio-active isotopes for studying the distribution of sodium and potassium in the tissues (Noonan, Fenn and Haege, 1941). When potassium is given to an animal it is soon excreted, and the extracellular fluid is left with only the minimal amount that is required to supply the demands of the cells. Sodium and chloride, on the other hand, are largely confined to the extracellular fluids; muscle cells are practically free from sodium and chloride, but an appreciable amount of sodium is present in the cells in the central nervous system. The influence of endocrine factors on the distribution of sodium and potassium has been discussed (Peters, 1942).

It has been reported that individuals who are subjected daily to low pressures, as in flying at above 12,000 ft., excrete on the average 100 per cent. more urine than when they remain at sea level (Silvette, 1942). Rats show the same phenomenon, and they are therefore available for experimental work on this form of diuresis. In rats that are repeatedly subjected to low pressures, a hypertrophy of the kidneys, adrenal glands and lymphoid tissue can be demonstrated.

The application of deuterium oxide (heavy water) to the cerebral cortex produces a state of catalepsy in cats and monkeys. Injected deuterium oxide disappears from the cerebrospinal fluid within 30 minutes. The replacement of 10 to 22 ml. of cerebrospinal fluid by deuterium oxide saline in catatonic patients produced no appreciable change in the psychiatric or neurological picture (Stern and Dancy, 1941). A cellular reaction was observed in the fluid but there was no change in the pulse rate, temperature, respiration, blood pressure, basal metabolic rate, blood cholesterol, glucose tolerance or kidney function.

Potassium.—Potassium is believed to affect the permeability and the electrical potential of the cell membranes. The role of potassium in relation to nervous activity may be that of modifying the responsiveness of the receptor to the neural transmitting agent.

Dawes (1941) has reinvestigated the vasodilator action of potassium, and his work clears up a number of earlier contradictions in the literature. The

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effects of potassium depend on the vascular tone, temperature and oxygenation as well as on the dose; they are complicated by the fact that potassium causes a release of adrenaline from the adrenal glands and these two principles act antagonistically. He concludes that the function of potassium is closely related to muscular work.

Thompson and Tice (1941) found that the effect of prostigmine in myasthenia gravis is related more closely to its action in liberating potassium from the muscles than to its anti-choline-esterase action. The effects of prostigmine in the dog also parallel the changes in the serum potassium rather than the inhibition of choline esterase. These experiments agree with the work of Cumings on the role of potassium in myasthenia gravis. The view that prostigmine acts in myasthenia by inhibiting the choline esterase is no longer widely held.

Water balance and epileptic seizures.—Greville *et al.* (1940) have made a careful study of the relation of water balance to seizures in epileptics. Their work is of particular interest from the point of view of experimental technique and the special precautions they took to eliminate all the possible sources of error. Their measurements, which extended over periods of up to five months, included the urine volume, body weight, insensible water loss and corrected water balance, as well as estimations of the total blood solids and the total plasma and non-protein nitrogen. They found that retention of body water did not always precede a seizure; at the most 10 seizures out of 22 were preceded by a rise in the weight curve. They concluded that water retention may be one of the factors which precipitate a seizure, or that the conditions which determine the onset of a seizure may on occasion influence the water exchange.

Stone *et al.* (1942), who used the specific gravity of the blood and serum as an index of hydration, also concluded from their experiments that water retention does not necessarily precede a fit; but relatively few of their patients gave seizures when tested by the hydration and pitressin method. Wachter (1939) obtained convulsions in 9 out of 15 epileptics after administering water and pitressin, while Blyth (1943) obtained seizures in 45 out of 49 patients by this method. The differences are most probably due in part to the different types of patients used and in part to differences in the experimental technique.

Menière's syndrome.—The labyrinthine apparatus would appear to be a particularly sensitive indicator of certain forms of metabolic disturbance, and there is evidence that a considerable proportion of cases are attributable to errors in the mineral or water metabolism. Attacks may be precipitated in certain patients by drinking fluids and, conversely, restriction of water intake may be used as a method of control. Some investigators have concluded that the serum potassium level is the most important factor, and considerable improvement has been reported from the administration of potassium by mouth. Horton (1941) believes that local oedema due to altered permeability of the capillaries of the labyrinth is the primary lesion, and he reports that treatment with histamine gave prompt relief from vertigo, nausea and vomiting in 49 consecutive cases.

Acid-base balance.—Gesell *et al.* have found that when the respiratory

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reflex is provoked by stimulating Hering's nerve in an anaesthetized dog, the time of after-discharge, as measured by the hyperventilation, is inversely proportional to the time of stimulation (Gesell, Brassfield and Hamilton, 1942). Such an inverse relation of after-discharge to stimulation stands in marked contrast to the established findings of Sherrington, according to which reflex after-discharge is directly proportional to the amount of stimulation. They conclude that the alkalosis due to the hyperventilation is the reason for the apparent discrepancy, and they attribute the effect to the decreased stability of acetylcholine in the central nervous system at an alkaline pH. While it is unlikely, in the reviewer's opinion, that the slight increase in the rate of acetylcholine breakdown associated with the observed pH shift from 7·47 to 7·62 can account for the effect, this peculiarity of the respiratory reflex would appear to be worthy of note.

Dyspnoea is one of the most constant symptoms in "effort syndrome," and Soley and Shock (1938) have concluded that "effort syndrome" results from the washing out from the blood of carbon dioxide by hyperventilation. Jones and Scarisbrick (1941) have made careful measurements of the respiratory exchange in a large number of patients with "effort syndrome," but their results do not confirm the views of Soley and Shock. The mean respiratory rate in the patients with "effort syndrome" was almost double that of normal controls, and a number of other differences were noted; but the mean minute volume in the patients with "effort syndrome" was normal when at rest. The respiratory response to exercise was greater in the "effort syndrome" patients, however, and persisted longer than in the normal controls. Patients with "effort syndrome" do not form a homogeneous group, and evidence was obtained that in one type of patient with "effort syndrome" the nervous symptoms of exhaustion may be due to an abnormally rapid rise in the blood lactic acid during exercise (Jones and Scarisbrick, 1942).

Evidence has been accumulating of an impairment of the mechanism for the maintenance of the acid-base balance in patients with epilepsy. Favill *et al.* (1940) found that 15 epileptic patients differed from normal in that the blood pH took much longer to return to normal after a period of over-breathing. There was also no compensatory fall in the alkali reserve. Gibbs *et al.* (1940) made serial estimations of the carbon dioxide content of the arterial and internal jugular vein blood in 94 patients with epilepsy and observed an abnormality in 70 per cent. Similar findings have been reported by other investigators.

Cerebrospinal Fluid.

Recent work has provided new data on the concentrations of a number of metabolites in the cerebrospinal fluid. Work on the detection of pathological constituents has continued. Friedemann (1942) has recently reviewed the literature on the blood-brain barrier, describing particularly the work on the permeability of the barrier to drugs, viruses, toxins and dyes.

Wallace and Brodie (1940) have reinvestigated the question of the source of the cerebrospinal fluid by injecting bromide or iodide into the systemic circulation, and by following the passage of these anions into the extracellular

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brain fluid and cerebrospinal fluid. Iodide injected intravenously reached a given concentration earlier in the extracellular brain fluid than in the cerebrospinal fluid. Bromide injected intravenously was found to enter the cerebrospinal fluid in a region of the cord that had been previously isolated by ligation from the cisterna magna. They concluded that anions are able to pass from the general circulation to the cerebrospinal fluid *via* the extracellular spaces of the brain and cord. Bernstein and Gregersen (1938) found that the two sugars, glucose and galactose, when injected into the subarachnoid space, disappeared at similar rates. Since glucose is rapidly utilized by the brain, while galactose is not, they concluded that the brain is unable to use metabolites such as glucose in the cerebrospinal fluid.

Estimations of the thiamin content of the cerebrospinal fluid by the phycomyces method have shown that up to 18 μg. per cent. may be present (Säker, 1940). The thiamin concentration in the cerebrospinal fluid is not directly related to the blood level, nor has it been shown to be related to any pathological condition. Intraspinal injection of thiamin is followed by rapid resorption into the blood from the lumbar and subarachnoid spaces, and conversely thiamin administered intravenously passes rapidly into the cerebrospinal fluid. Intraspinal injection has thus no advantage over any other route for administering thiamin.

The presence of choline esterase in the cerebrospinal fluid has been demonstrated in 23 individuals who were believed to be normal (Birkhäuser, 1941). The amount present is far lower than in the blood and varied from 4 to 24 (expressed as cu.mm. CO_2 per 0·5 ml. cerebrospinal fluid per 120 minutes) with a mean of 14. There was no connection between the choline esterase and the leucocyte count. The mean choline esterase activity in 18 schizophrenics was 19·4.

Proteins and other foreign substances inhibit the crystallization of crystalloids, and a simple test, based apparently on this principle, has been devised by Tonesco for detecting abnormal constituents in the cerebrospinal fluid. Changes in the crystal habit of sodium chloride are observed when small amounts of cerebrospinal fluid are added to a drop of 0·8 per cent. sodium chloride solution, which is evaporated on a microscope slide. The value of the test has been investigated in a variety of pathological conditions (Ström-Olsen and Kite, 1942). The test is strongly positive in general paresis. While the precise physiochemical basis of the test is obscure, it is of interest in view of its extreme sensitivity. Ford Robertson and Colquhoun (1940) have obtained new data on the mechanism of the Meinicke clarification reaction. Perelli (1941) has studied the calcium chloride flocculation test in 13 cases of acute poliomyelitis. He concludes that the test is valuable in diagnosis, and it may be useful in following the treatment.

Experimental Techniques.

One of the most promising features of recent biochemical work has been the rapid development of new experimental techniques. The chemical methods for the separation and isolation of the chemical constituents of the tissues have

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been extended by the introduction of a wide variety of new adsorption techniques, which are now penetrating into every field of biochemistry. Specific adsorbants for the separation of basic substances such as acetylcholine and histamine, for example, are now available. There is also a noticeable increase in the delicacy of the chemical methods employed, so that substances too unstable for isolation by the older methods can now be handled satisfactorily.

Micro-analytical methods are still developing rapidly, and the literature contains a large number of new methods and new modifications of methods for estimating the more important constituents of the tissues. Ultra-violet fluorimetric methods enable vitamin B_1, for example, to be estimated in quantities of less than a millionth of a gramme. Vitamin C can be estimated in the blood. Estimations of blood iodoprotein have been used for controlling the treatment of patients with thyroid disorders. Many of the phosphorylated intermediates in carbohydrate metabolism can now be estimated, and an enzymic method based on catalysis of the breakdown of hexosediphosphate is used for estimating cozymase. Brand and Sperry (1941) have described a new method for estimating cerebrosides by hydrolysing with acid and titrating the galactose formed with ceric sulphate. These are only a few examples of a large number that might be cited.

Apart from chemical methods a number of new physical methods are finding increasing application in biochemistry. Electrophoretic methods for separating proteins may be mentioned in this connection, and also the glass electrode method for estimating the pH of the blood. The photoelectric absorptiometer has replaced the colorimeter for many purposes, and by the use of special colour filters greater selectivity can be obtained than is possible by eye. Microrespirometric methods have improved, so that the respiration of less than 1 mgm. of tissue can now be measured.

The method of labelling molecules by the use of isotopes such as deuterium, isotopic carbon and radio-active phosphorus is an important new development. Radio-active phosphorus (P^{32}), for example, is prepared by the bombardment of P^{31} with deuterons accelerated in the cyclotron. The radio-active phosphorus can then be estimated in the presence of inactive phosphorus with the Geiger-Müller counter.

These experimental methods are still comparatively new in biochemistry, but it is clear already that some of them have important applications in the study of the nervous system and so, ultimately, will help towards solving the problems of psychiatry.

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VITAMIN DEFICIENCY AND THE PSYCHOSES.

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A state of vitamin deficiency arises (i) when inadequate amounts of a vitamin (or vitamins) are ingested, (ii) when absorption from the alimentary canal is defective or interfered with, (iii) when storage mechanisms are at fault, e.g. liver disease, and (iv) when the tissue cells themselves are unable to utilize the vitamin (1, 2). With war rationing the first factor is likely to be commoner than [illegible]fore, especially in alcoholics (3), patients maintaining a strict "peptic ulcer diet" over long periods (4), diabetics (2), mothers sacrificing their rations for the family, food faddists, and in people living alone and doing their own cooking (5). Nowadays many exist on a "borderline" diet, in whom any stress such as pregnancy, infection, surgical procedure, fracture, hyperthyroidism, etc., will precipitate a deficiency state; moreover, in chronic gastro-intestinal disorders the available vitamins may be lost or destroyed (6–14).

Although there is evidence that vitamins A, C and E may be associated with some neurological disorders, in the present state of our knowledge the only vitamins proven to have a causal relationship with certain neuropsychiatric syndromes are to be found in the B complex. These are thiamin and nicotinic acid (15). Riboflavin, pyridoxine and biotin are possibly implicated, but their precise role is not yet established (16–18).

The exhibition of a specific vitamin may not relieve all the symptoms of a deficiency state, as several factors of the B complex are usually involved—in fact, a secondary deficiency state which had been latent may become activated (2, 7).

The acute encephalopathic syndromes (*vide infra*) are likely to be encountered amongst cases of confusion and delirium in the wards of a general hospital. Whilst they may occur infrequently, it is probable that an increasing number of psychotics will be recognized as having their mental pictures coloured or complicated by symptoms indicating B deficiency. Amongst the psychoneuroses a proportion of cases will in all probability be found to be suffering essentially from a subvitaminosis.

Thiamin (Vitamin B_1 or Aneurin).

Thiamin plays an important part in the fundamental processes of oxidation in the living cell; it is active as a coenzyme in the oxidation of carbohydrate (19, 20). Its lack may produce reversible changes in neurones of the C.N.S.

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1. *A "Neurasthenic" Syndrome.*

This is probably the earliest and most frequent manifestation of thiamin deficiency. Symptomatology is varied, but anorexia, fatigue and insomnia are outstanding. Irritability, inability to concentrate, mild depression, headache, backache, constipation, flatulence, etc., are common (21–24). Williams and his co-workers (25, 26) induced B_1 deficiency in volunteers, producing similar symptoms. They state: ". . . At the end of the period of deprivation of thiamin the clinical picture in all our cases was that of anorexia nervosa, and this condition as one encounters it clinically is usually an end stage of more severe neurasthenia. . . ."

O'Shea *et al.* (27) induced a comparable deficiency syndrome, and noted that the subjects seemed confused and less able to reason and exhibit good judgment. They found that foresight and judgment, as measured by performance on the Porteous maze tests, were impaired, but that tests for general intelligence, reasoning ability and speed of hand-muscle co-ordination showed no impairment of these functions.

That every case of "neurasthenia" is due to vitamin deficiency is obviously absurd, but the probability remains that some cases are nutritional in origin.

II. *Wernicke's Encephalopathy.*

This syndrome, which often has an abrupt onset, is probably not uncommon. It is "traditionally associated with alcoholism," but it may occur as a terminal complication of other diseases, particularly chronic gastro-intestinal disorders (e.g. gastric carcinoma) (28, 29). The pathological changes are briefly: foci of vascular stasis and parenchymatous degeneration in the peri-aqueductal grey matter of the mid-brain and the floor of the fourth ventricle (24, 28, 30). The work of Alexander and his associates (31–33) has established that the lesions occurring in man and those produced by experimental thiamin deficiency in pigeons are identical in topographical distribution and histological characteristics.

Although the original clinical features described by Wernicke were clouding of consciousness, varying ophthalmoplegias and ataxia, a wider range of symptomatology is being recognized (34). Thus the mental picture may present clouding of consciousness of any degree from drowsiness or apathy to delirium and complete coma. The most characteristic focal neurological manifestation is paralysis of conjugate eye movement (although any type of internal or external ophthalmoplegia may be encountered). A disturbed respiratory rhythm is said to be of diagnostic value (28), and nystagmus may be present or may appear only after the ophthalmoplegia has cleared. Polyneuropathy in the lower limbs is frequent; according to Jolliffe (34) this invariably precedes or accompanies the ophthalmoplegia. Recently Wortis, Jolliffe *et al.* (3, 24) suggest that whilst the mental changes and the ophthalmoplegia are associated with B_1 deficiency, the syndrome as a whole is due to a multiple deficiency.

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III. *Korsakov's Psychosis.*

Considerable doubt exists as to the role which thiamin plays in this psychosis (3, 15, 24, 35). The syndrome may be encountered following head injury, subarachnoid haemorrhage, etc.—conditions in which the pathogenesis is seemingly unrelated to dietary deficiency. Even where alcohol appears an aetiological factor many cases are known to recover without special therapy. Again, it is said (29, 34) that some patients with Wernicke's disease, treated by intensive thiamin, are left with a residual Korsakov's psychosis unaffected by continuation of therapy. Despite these criticisms, certain workers (36, 37) are convinced of the close relationship between the psychosis and B_1 lack. They explain the failures by postulating that in these cases irreversible structural changes have occurred already. We must record that in our experience, prolonged thiamin therapy has produced beneficial results on either the mental symptom-complex, or the polyneuropathy, or both.

IV. *Delirium Tremens.*

There is evidence of nutritional deficiency and a disturbed carbohydrate metabolism in delirium tremens but the problem is exceedingly intricate (29, 38). There appears to be little incontrovertible evidence that the B complex is related to its pathogenesis, despite many favourable reports of B therapy in the literature (15, 35). However, delirium tremens may be followed or complicated by an encephalopathic syndrome of the Wernicke or nicotinic acid deficiency type (24, 29). Whilst the treatment of the dehydration usually found in this condition is of paramount importance, the exhibition of large doses of thiamin at the same time in the experience of one of us (W. A. C.) apparently lowered the mortality-rate considerably.

V. *The Polyneuropathies and Related Disorders.*

A polyneuropathy (polyneuritis), occurring in any systemic or mental disorder, which is bilateral and symmetrical and which manifests itself primarily and most severely in the lower limbs, is likely to be due to thiamin deficiency. Polyneuropathies intimately associated with avitaminosis occur in beri-beri, pellagra, sprue, alcoholism, pernicious anaemia, pregnancy, diabetes, hyperthyroidism, and in the cachexias of new growth, senility and tuberculosis (2, 11, 14, 35, 39, 40). Single, unilateral or local neuritides are almost certainly not related to B_1 lack (2, 10).

Beri-beri.—Although a psychosis has not been described in beri-beri, the experimental work of Williams *et al.* (41) suggests that mental symptoms may accompany the well-known somatic changes.

Pernicious anaemia and subacute combined degeneration (2, 35, 42–45).—In the past few years we have encountered several patients suffering from pernicious anaemia, or subacute combined degeneration, who developed an acute psychosis of either a confusional character or a depression with persecutory delusional ideas. The psychosis has cleared up within a few weeks with parenteral crude liver extract. Until recently we presumed that the main aetiological factor concerned was that responsible for the anaemia. Now one

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questions to what extent did B complex lack participate in the mental picture. It was noted that when using the crude extracts the mental state appeared to improve more rapidly than the blood picture.

Laboratory Aids in the Diagnosis of Thiamin Deficiency.

Several methods are available to assess the thiamin status. The thiamin content of the blood or of the urine can be measured by chemical means, e.g. the thiochrome method (46–48), or by microbiological methods, e.g. a yeast-fermentation test (46). By the latter the blood value has been found to average 5·4 μg., whilst values below 3 μg. are said to occur in cases of peripheral neuropathy or Wernicke's disease. Again, urinary excretion of thiamin is diminished in thiamin deficiency and a saturation test has been devised—said by some to be the most reliable (49). The blood cocarboxylase gives a good indication of thiamin saturation of the body (5). More recently the rise in the bisulphite-binding substances of the blood, particularly pyruvic acid, has been utilized (24, 50, 51). Thus, Williams and his co-workers (41) believe that abnormal changes in the pyruvic acid, lactic acid and dextrose of the blood following oral or intravenous dextrose furnish the most reliable test of the severity of metabolic defects in thiamin deficiency.

Treatment.

As in all vitamin deficiency states, treatment is twofold: (*a*) provision of a balanced highly nutritious diet of natural unrefined foods, and (*b*) the administration of the specific factor or factors.

In treating B_1 deficiencies, dosage must be large, particularly in the acute encephalopathies, where prompt and adequate treatment may be a life-saving measure, and it should be administered parenterally. Also, where there is reason to believe that the avitaminotic state is due to an absorption failure, the factor should be given parenterally. Jolliffe (15) suggests the following dosage, and in the treatment of over 3,000 cases claims that he never experienced toxic symptoms:

TABLE.—*Parenteral Thiamin Treatment (after Jolliffe).*

Disease or syndrome.	Amount in mgm.	Frequency.	Comment.
Neurasthenic	10–30	Daily	Trial of at least 3 weeks if less than 3 months' duration; if of longer duration trial of at least 3 months.
Polyneuropathy:			
Mild	10–30	,,	10–21 days.
Moderate	20–50	Twice daily	3–6 weeks.
Severe	20–100	,, ,,	3–6 weeks, then in smaller doses until well after improvement ceases.
Wernicke	50–100	Three times daily	2–7 days.

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Nicotinic Acid (Niacin, P-P Factor).

Nicotinic acid is chemically related to nicotine. In the body nicotinic acid amide combines with other compounds (adenine, phosphoric acid, etc.) to form a coenzyme essential for the transference of oxygen in the fundamental processes of the cell (19, 20). The body cannot synthesize nicotinic acid, and without it coenzyme formation is impossible (52). Although much is known of the manner in which this coenzyme acts, it is still obscure as to its relationship to pellagra.

Storage is better than with thiamine, and the tissues in a deficiency hold on to nicotinic acid, in the form of a coenzyme, tenaciously, so that with obvious pellagra the nicotinic acid content of the whole blood may not fall below that found in normal controls (53).

Pathology.

There are no specific changes in the C.N.S. in pellagra, but according to most writers the occurrence of primary irritation of large nerve cells such as the Betz and anterior horn cells, either alone or in combination with hyaline changes of the cerebral blood vessels, and degeneration of the posterior and lateral tracts in the spinal cord, are highly suggestive. The lesions in the spinal tracts are probably of a Wallerian type, and are not to be confused with subacute combined degeneration. In uncomplicated cases the spinal roots and peripheral nerves are not affected (1, 54).

Commenting in general on the selective affinity of the vitamins for certain parts of the C.N.S., Hsü remarks: ". . . The distribution and the order of frequency of the lesion in the one condition (beri-beri) are more or less the reverse of the other. In beri-beri the peripheral nerves are the primary seat of damage, while in pellagra the brain seems to be the early focus of disturbance. As the disease progresses farther the process of degeneration extends centripetally in beri-beri and centrifugally in pellagra."

It has been found that in pellagra complicated by beri-beri the cerebral metabolism (as measured by the oxygen utilization, and the glucose and lactic acid levels of the arterial and venous blood) is decreased. Himwich, Spies *et al.* (55) state that such observations may afford a basis for the explanation of the mental changes.

I. *A Neurasthenic Syndrome.*

Spies and his collaborators (2, 23) found that a syndrome simulating or identical with "neurasthenia" frequently preceded the onset of pellagra. Many authorities now regard mild nicotinic acid deficiency as a definite clinical entity, with a symptomatology similar to that previously described for B_1 "neurasthenia"—a condition not necessarily developing into a fully blown pellagra. It may well be commoner in this country than is appreciated.

II. *Pellagra.*

It was estimated that in the U.S.A. in 1938 there were 100,000 pellagrins (56). Its rarity in Great Britain is possibly due to lack of recognition (57).

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The diagnostic triad, "dermatitis, diarrhoea and dementia," is out of date (8). The signs and symptoms characteristic of the disease are: mental abnormality, weight loss, stomatitis, glossitis, dermatitis, porphyrinuria, diarrhoea, tachycardia, peripheral neuropathy and vomiting, in their relative order of frequency (15, 58, 59). All are not necessarily present in the same case. The mental symptoms may be mild, and "psychoneurotic" in type: a dislike of bright lights, of noise, of strong odours or tastes; fidgetiness; a feeling of being on edge; apprehension, and increased emotional excitability (60). "Pellagrins" describe their symptoms as being strange to themselves. They tire easily, perhaps suffer from insomnia, headache, nausea and vomiting. Glossitis is constantly present, but it is often mild and may be confined to the tongue margins. The characteristic symmetrical dermatitis may be preceded by diarrhoea of many months' duration. Probably in this country, dermatitis should not be regarded as a necessary diagnostic sign (pellagra sine pellagra). Stannus (45) has called the incomplete stage (stomatitis without other symptoms of pellagra) "pellagra fruste," others "larval pellagra." The polyneuropathy seen in some cases may be mild or severe; it has been shown to be due to thiamin deficiency and not to lack of nicotinic acid (2, 13, 62, 63). Of particular interest are those cases presenting severe psychotic disturbances in addition to the characteristic somatic signs. States of confusion are commonest, but manic-depressive, delirious and paranoid reactions have been described (23, 29). Spies and others (7, 13, 58, 64, 65) point out that severe mental disturbances indicate a very advanced stage of the disease, and that they are preceded by the milder symptoms enumerated above.

That pellagra is encountered relatively frequently in mental hospitals is well recognized (57, 66–68). What is not appreciated is that a number of chronic deteriorated patients may suffer from a concomitant chronic pellagra. Chronic pellagra is known to produce irreversible organic changes in the C.N.S. (2, 3). The deterioration in some long-standing schizophrenic patients may be associated with the pellagrinous changes. Sydenstricker (7) has pointed out that early diagnosis is important and treatment is often necessary over a prolonged period; treatment in the later stages of the disease may be disappointing and indeed useless (21, 29). Mindus (69) has examined a group of 60 female patients in a Swedish mental hospital, with "neurasthenica gastrogenica," in which the predominating symptoms were depression with or without paranoid trends, lassitude, anorexia, weight loss, anaemia, insomnia and hypochlorhydria. He treated half the group with a high calorie diet rich in vitamins. Those so treated fared "strikingly better" than the controls. Our observations at West Park lend support to the views expressed above. We have recently observed a number of cases of frank pellagra amongst the "chronic" patients, and we suspect that there are many more cases of pellagra sine pellagra. We consider that such symptoms as the following should lead one to suspect niacin deficiency: unexplained diarrhoea, particularly if long standing and intermittent; abnormalities of the tongue—undue redness, marginal indentation, atrophy of papillae (45); weight loss (sudden or gradual), especially when this cannot be accounted for by intercurrent disease or reduced dietary intake. In our series of pellagrins the initial lesion in two cases which

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led to the subsequent diagnosis was an ulceration of the vulva and perineum, possibly secondary to chronic vaginitis. The following factors may be peculiarly favourable to the development of the disease in mental hospitals: faulty feeding habits, dysentery, and prolonged sedation (e.g. with barbiturates).

III. *Nicotinic Acid Deficiency Encephalopathy.*

In 1940, Jolliffe and his co-workers (70) reported 150 cases of an "encephalopathic syndrome" characterized by clouding of consciousness, cog-wheel rigidity of the extremities and uncontrollable grasping and sucking reflexes. They believed that this condition was essentially the same as that described by Bender and Schilder (71) under the name "encephalopathica alcoholica." In Jolliffe's opinion the syndrome does not occur exclusively in chronic alcoholics; it may be the only manifestation of a deficiency disease, or it may occur in association with pellagra, with the polyneuritis of B_1 deficiency, or with the ophthalmoplegia of Wernicke's disease (15, 29). The differential diagnosis from such conditions as delirium tremens, the deliria of infectious disease, intracranial tumour or cerebral arteriosclerosis, in which groping, grasping and sucking, etc., may occur also, can present considerable difficulties. Examining the past records of such cases it was found that the mortality-rate was high (90 per cent.). The usual treatment given in the past had been large quantities of saline. Jolliffe continued the intensive hydration treatment in his cases; he added B_1 alone to one group, and nearly all the patients died; when a high vitamin diet was given 50 per cent. of cases survived, whilst in a further group treated with nicotinic acid by mouth, and parenterally, the survival rate increased to about 85 per cent. In the light of these experiences, Jolliffe concluded that pellagra was a "partial nicotinic acid deficiency," whilst the encephalopathy was a complete one. The only similar case recorded and treated successfully in this country is that described by Slater (72), who rightly points out that a number of such cases may lie unrecognized in general hospitals.

IV. *Nicotinic Acid Deficiency States Associated with Atypical Psychosis* (2, 3, 73).

Recently Cleckley, Sydenstricker and Geeslin (73) reported upon 19 severely undernourished patients whose psychoses were of the pattern seen in pellagra, but in whom there was no overt, frank clinical evidence of the latter disease. Some degree of glossitis was present in 17 of the cases, 5 cases presented deafness as a symptom, 2 a mild non-specific vaginitis, 1 diarrhoea and 1 stomatitis. The mental picture varied from "hebetude to profound stupor." Most of the cases occurred in elderly individuals, 2 only were chronic alcoholics, and 1 suffered from cerebrospinal syphilis. Dramatic "cure" was reported following intravenous nicotinate in 15 cases. In the opinion of the authors such cases are often perfunctorily diagnosed as cerebral arteriosclerosis, and inadequately treated until death from bronchopneumonia supervenes. They were convinced that a therapeutic test with nicotinic acid is justified in all cases of unexplained hebetude or unconsciousness. Jolliffe, commenting on these cases, considered that a few fitted into his conception of an encephalopathic syndrome (*vide supra*). In a later paper Sydenstricker and Cleckley (74)

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reported a further series of cases, and although many of these were confused, lethargic or even comatose on admission, some exhibited "manic excitement." In nearly all this group a red tongue was the only abnormal physical sign indicating deficiency, although the psychosis complicated or followed serious physical conditions, such as arteriosclerosis, hemiplegia, peptic ulcer, prostatectomy, fractured femur and pneumonia. The authors state that ordinarily "toxic psychosis" is the diagnosis.

Laboratory Aids in the Diagnosis of Nicotinic Acid Deficiency.

At the present time there seems to be no satisfactory chemical or biological test available (5, 7, 46, 53). Despite the contention of some authorities that porphyrinuria is an integral part of the disease, it is doubtful if it is an essential feature of pellagra and it does not aid in the diagnosis (53, 75). Nicotinic acid determined chemically has not significantly different values in the blood of pellagrins and in those of normal controls (76). "Tolerance curves" have not proved of value. One of the most promising tests is that for the bluish fluorescent substances F_1 and F_2 in the urine (5). F_1 is said to occur in high concentration in pellagra, whilst F_2, which is present in normal urines, is reduced in pellagra. Administration of nicotinic acid reduces the F_1 content and F_2 reappears in the pellagrin's urine (46). The urinary excretion of trigonelline may prove to be a useful measure of nicotinic acid deficiency (76, 77).

Treatment.

Pellagra is treated with an abundant high calorie diet and the specific vitamin (59, 78). In the early stages milk and meat juices may have to be the mainstay owing to the painful mouth lesions and the gastric disturbances. The dosage of nicotinic acid recommended is 500 to 1,000 mgm. each day in the early stages of treatment (2, 15, 59, 79). It should be given in ten divided doses of 50 mgm. or 100 mgm. each hour during the day. If nicotinic acid amide is given instead, the dosage recommended is 15–30 mgm. every hour for ten hours a day. The effect of this régime is little short of dramatic, the lesions of the mucous membranes often yielding to treatment within a day or two. Improvement in the mental state is usually evident within a few days, but the skin lesions may take a fortnight or longer to clear (7, 58).

The addition of brewer's yeast, 15–30 gm. daily, is advisable owing to the danger of precipitation of latent deficiencies in other B factors, e.g. thiamin or riboflavin ("concurrence of vitamin deficiency diseases"). If there are definite signs of thiamin deficiency before treatment this vitamin should be administered together with the nicotinic acid (2).

Later when the patient is apparently well a maintenance dose of 25–50 mgm. nicotinic acid three times a day should be given for a prolonged period in addition to the continued enriched diet (24).

The treatment of the "atypical psychoses" (Group IV above) and of the encephalopathic syndrome is very similar to that outlined above. It is very likely that in the early days tube-feeding will be necessary and dehydration will need combating by intravenous glucose saline. The specific therapy

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should be given partly by parenteral means. Jolliffe (15) recommends 100–200 mgm. nicotinic acid amide parenterally each day, and 500–1,000 mgm. nicotinic acid by mouth if the patient is able to swallow. This dosage is sustained for 3–7 days and thereafter smaller amounts are given by mouth.

Recently Sydenstricker (5) has suggested that a combination of vitamins may be preferable to thiamin in the treatment of Wernicke's disease. He has used a mixture of 50 mgm. nicotinamide and 5 mgm. each of thiamin, riboflavin, pyridoxine and calcium pantothenate, given by injection six times daily.

In the neurasthenic syndrome Jolliffe (15) recommends daily doses of 100–300 mgm. nicotinamide by mouth in addition to an enriched diet. As with the thiamin deficiency neurasthenic state, therapy should be tried for three months, or longer. Ruffin (21) adds a word of caution, stating that his experiences in the treatment of patients suspected of a mild deficiency are disappointing, and that the improvement noted in some cases may be temporary and due to suggestion. He considers vitamin therapy to be dramatic and unequivocal; that a trial of longer than three or four weeks has no justification. However, Williams's experimental work argues in favour of a longer trial, as he found a slow disappearance of the induced signs and symptoms when the restriction of vitamins in his subjects had been moderate and prolonged.

The hypochromic anaemia associated with nicotinic acid or riboflavin deficiency or in multiple neuritis does not respond to yeast, but does so to iron (80).

Since nicotinic acid has been found so effective in elderly arteriosclerotic patients, some authorities have argued that it exerts its beneficial action by its vasodilator effect on the cerebral vessels. This seems unlikely since nicotinamide and nikethamide (coramine, a related compound) are as effective as nicotinic acid in treating the acute deficiencies, and these substances have little vasodilator action (5).

The toxic manifestations of nicotinic acid consist of burning and itching sensations in the skin, particularly over the face and ears, occurring shortly after administration and persisting up to 20 minutes (59). The peripheral vessels are dilated and the skin temperature increases—in fact the patient's aspect may simulate scarlatina. The blood pressure may fall and nausea and vomiting can occur. A reduction in dosage or a temporary cessation of treatment is then indicated. There is no evidence that nicotinic acid in the dosage mentioned is dangerous to life. Nicotinamide is much less toxic (81).

Riboflavin (Vitamin B_2), Pyridoxine (Vitamin B_6) and Pantothenic Acid.

There is no evidence at present that riboflavin is related directly to neuropsychiatric conditions (35). Nevertheless, together with nicotinic acid and thiamin it is a component of the coenzymes essential in the intermediate stages of carbohydrate metabolism (24). The physical signs of ariboflavinosis are, briefly: angular stomatitis (cheilosis), nasolabial seborrhoea—often involving the eyelids and ears also—"shark skin" appearance of cheeks and chin, a peculiar glossitis (flattened mushroom-shaped papillae) associated with a

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magenta-coloured tongue, and eye changes from mild circumcorneal injection (which may only be detected with a slit-lamp) to corneal vascularization and opacities (16). Ariboflavinosis may be precipitated in pellagra when large amounts of nicotinic acid are administered to a patient who maintains an inadequate diet (7, 16).

Spies *et al.* (17) treated large numbers of undernourished persons with clinical evidence of pellagra and beri-beri with nicotinic acid, thiamin and riboflavin. The diet of a few of these patients remained the same since they did not regain strength enough to restart work and so earn sufficient to buy better food. The residual symptoms included "extreme nervousness, insomnia, irritability, abdominal pain, weakness and difficulty in walking." Intravenous synthetic vitamin B_6 produced dramatic relief within four hours of administration. Spies concludes that pyridoxine is an important factor in human nutrition, and claims that these observations support the hypothesis that clinical deficiency diseases occur as complexities and not as single entities.

Pyridoxine may mobilize riboflavin from storage, or dissociate it from some combination in which it is physiologically active. Pantothenic acid may have a similar action (16, 82). Pyridoxine has been used in progressive muscular atrophy and the dystrophies, sometimes in combination with α-tocopherol. The consensus of opinion is that its value is very doubtful and its use in cases of Parkinsonism is disappointing (35, 53, 55, 83).

Vitamins A, C and E.

Vitamin A deficiency in young animals is said to stop skeletal growth whilst the soft tissues, including the nervous system, continue to grow (84). The possible clinical implications in man have not been formulated (5, 46).

It seems likely that the depletion of ascorbic acid which occurs in certain illnesses associated with alcoholism (e.g. delirium tremens) is a predisposing factor in subdural haemorrhage following injury (33, 85). Bowman and Wortis (86) point out that the vitamin C values in the blood and C.S.F. of delirium tremens are low. They consider that even if the subvitaminosis is not directly related to the production of the delirium, therapy may prevent and combat intercurrent injection.

The role of vitamin C in the senile psychoses and in senility has been questioned recently. The skeletal changes in senility and in scurvy are said to be similar (19). Berkenau (87) suggests that the delay in saturation in his small group of psychotic patients may be significant. Rafsky and Newman (88) found high retention values in their subjects, whilst the clinical experiences of Stephenson, Penton and Korencheowsky (89) suggested that combined B and C therapy "prevented or improved certain features"—muscular, cardiovascular and mental deterioration: benefit was recorded in the perceptual, cognitive and emotional spheres. However, Moore (90) considers that small doses of thiamin and nicotinic acid counter certain adverse symptoms in aged patients. Wexburg (91) has described a syndrome consisting of acute or subacute mental disorder of the organic reaction type, usually associated with postero-lateral sclerosis, sometimes with polyneuritis, often with hypochromic or hyperchromic anaemia, and hypochlorhydria ("senile encephalomyelosis").

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He recommends treatment with the B complex, and suggests that all cases of deliria and confusional states in the senium should be examined and treated from the hypovitaminotic point of view.

On the basis of the experimental production of nutritional myopathy and encephalomalacia in chicks, etc., lack of vitamin E has been incriminated in amyotrophic lateral sclerosis, the myopathies and in tabes dorsalis. The evidence of its therapeutic value is doubtful, and its relationship to disease of the nervous system in man is at present not clear (5, 53, 64, 83, 92–96). Vitamin E lack is known to produce degenerative changes in the germinal layers of the testes in rats and morphological changes in the anterior lobe of the hypophysis (19). It is possible that these and similar observations in experimental deficiency may prove to be of importance in the advance of psychiatric know ledge.

Conclusion.

That adequate nutrition is essential for the physical and mental well-being of the individual can be regarded as axiomatic. However, our knowledge of the relationship between inadequate nutrition and mental ill-health is depressingly meagre. The rapid flood of research on vitamins in the last few years has caught up the psychiatrist in its swirl. Although it behoves us to be cautious when all and sundry are vitamin-minded, recent work strongly suggests that some mental disease is produced by a lack of these accessory food factors. This paper is an attempt to reproduce recent views in a brief form, and the classification adopted must be regarded as purely arbitrary.

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NEURO-ENDOCRINE RELATIONSHIP.

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Introduction.

In recent years our views of the interaction between the nervous system and the ductless glands have been gradually more defined. In the present review, for descriptive reasons the subject has been classified as follows with reference to the main elements of the neuro-hormonal inter-relation :

(1) The influence of the nervous system on the pituitary itself and, through the pituitary, on the other ductless glands.

(2) The influence of the ductless glands and their secretions on the functions of the nervous system.

The factors concerned and the paths of their action can be summarized as follows :

(*a*) The reactions between the brain cortex and subordinate brain centres, *e.g.* the hypothalamus.

(*b*) The direct excitatory or inhibitory effect of the hypothalamus on the pituitary.

(*c*) The functional regulation of the subordinate ductless glands by the different trophic hormones produced in the pituitary anterior lobe.

(*d*) The action of the ductless glands and their hormones on the body.

(*e*) The centripetal nervous impulses from the periphery to the brain cortex.

(*f*) The nervous impulses from the periphery to the hypothalamus.

(*g*) The action of the ductless glands and their hormones on the different elements of the nervous system.

The variety of factors concerned shows the very complex character of the neurohormonal relation. Mental disturbances, emotions, affections may produce endocrine disturbances, and these, in turn, may affect cerebral functions. Pathological processes may very often result from such vicious circles. The necessity for considering these facts in the analysis of pathogenetic syndromes is obvious.

Nervous regulation is not indispensable for the functioning of the ductless glands, but it serves to maintain the hormonal balance in the body, and regulate certain cyclic hormone functions and the reactions of certain ductless glands to changes in the environment. The hormones regulate the orderly functioning of the nervous system. Thus not only is cortical activity influenced by the ductless glands as in disorders of the thyroid, but the autonomic system is even

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more directly influenced by the hormones. So far little is known of the relations between the hormones and the functions of the central nervous system, but recent investigations promise rapid progress in this all-important branch of neurophysiology.

There is evidence that the brain is a possible storage organ for certain hormones. In this connection may be cited the old experiments by Schittenhelm showing that iodine is stored in the tuber cinereum after thyroid administration. The recent experiments by Selye (1941) showing the possibility of inducing anaesthesia by administration of desoxycorticosterone and other steroid hormones are suggestive. It is possible that certain cell elements among the glia cells of the brain serve as storage organs for certain substances necessary for the brain function, e.g. hormones or even pre-hormones of lipoid character, which are partly released as soon as necessity arises, partly continually used by the cells. Series of ketosteroids from the brain have been isolated in the Burden Laboratories and will be described in due course.

The alleged secretory activity of neurons in the hypothalamus has been recently reviewed by Scharrer and Scharrer (1940). The cells in question are multinucleated, and have inclusions of colloid material and granules which are regarded as the product of the secretory activity of the cells themselves. Situated mainly in the nuclei supraopticus and paraventricularis, they are vascularized by an exceedingly dense capillary bed. The nerve cells are partly directly attached to the vessels lining them in a dense epithelium-like pattern. All the morphological investigations dealing with the so-called secretory cells of the hypothalamus are likely to remain inconclusive so long as the problem has not been studied by the methods usually applied in endocrine work. Since extirpation experiments cannot be carried out without damaging the total hypothalamus, the only really decisive method would be the preparation and biological investigation of extracts from large aggregates of hypothalamic nuclei.

The Influence of the Hypothalamus on the Ductless Glands and their Functions.

Le Gros Clark (1938) regards hypothalamus and pituitary as parts of a common functional mechanism. Not only do excitatory and inhibitory impulses to the pituitary from various parts of the central nervous system traverse the hypothalamus, but also stimuli arriving from the periphery.

The anatomical details of the nervous connection between pituitary and hypothalamus have been reviewed recently by Ingram (1939, 1940). The main component of the so-called hypothalamico-hypophysial tract is the supra-optical-hypophysial tract. Its fibres are accompanied by others coming from different sources, particularly from the tuber region and from the nucleus paraventricularis. According to Brooks and Gersh (1941) most of these nerve fibres end in the neurohypophysis, but many continue in the pars intermedia and the anterior lobe. In the latter these fibres are supplemented by a smaller number of unmyelinated fibres originating from the carotid plexus. Hair (1938) suggested that they reach the gland together with the entering vessels, partly directly, partly after having passed the posterior lobe. As these fibres

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are not completely destroyed by cervical sympathectomy, they do not all originate from the ganglion cervicale superius, and it has been assumed that in cats some of them are coming from the glossopharyngeal nerve, and belong to the parasympathic system. These nerve fibres terminate as a pericellular network round the secretory cells of the anterior and posterior lobe (Hair, 1938 ; Brooks and Gersh, 1941). The secretory function of the latter is carried out by cells resembling the so-called pituicytes which survive, grow and expand in a network in tissue culture, whilst the nerve fibres degenerate (Griffiths, 1938).

After hypophysectomy or lesions of the stalk, retrograde degenerative changes take place in the hypothalamic nuclei. White and Heinbecker (1939) reported definite changes in the supra-optic and paraventricular nuclei in dogs after hypophysectomy. Magoun and Ranson (1939) found a loss of about three-quarters of the cells of the supra-optic nucleus nine to twelve weeks after interruption of the stalk in monkeys. Rasmussen has recently carried out most extensive investigations on the subject (1940). According to this author, the cells in the supra-optic nucleus of normal rats number about 7,000. Ten days to three weeks after hypophysectomy or transection of the stalk a marked decrease of cells takes place, while the nucleus supra-opticus of a rat killed 154 days after operation contained only 1200 cells. The supra-optic nucleus of a rat hypophysectomized at the age of 77 days and killed 149 days afterwards contained less than 1,000 cells. The paraventricular nucleus, however, did not show an actual loss of cells in these experiments. While the normal supra-optic nucleus of a dog contains 35,000 to 41,000 cells on each side, six months after transection of the hypophysial stalk only 3–4,000 cells could be counted. In dog-pituitaries after transection of the stalk there is a certain amount of atrophy, though histologically the tissue appears to be normal. The supra-optic nucleus of man contains normally about 60,000 cells. Five months after cauterization of the hypophysial stalk of a 46-year-old man, who had suffered from hypertension, only 9,200 cells could be found in the right nucleus supra-opticus, and 8,700 in the left. The weight of the pituitary was only half the average, the anterior lobe being below the normal minimal size. About a quarter of it was fibrosed, and less than half the normal amount of parenchyma was present. The infundibular processus was about one-eighth of the average size ; the pars intermedia, however, appeared to be normal. Some basophil invasion into the neural lobe could be traced (Rasmussen, 1940).

The part played by the hypothalamus in the physiological control of the pituitary function has been demonstrated by experiments, in which the effect of destruction of certain parts of the hypothalamus or transection of the stalk on the pituitary hormones was studied. Though no assay was made of the hormone content of the body fluids after such manipulations, the functional changes supply ample evidence for the physiological interdependence of the hypothalamus and pituitary. The technical difficulties involved in attempts to injure the hypothalamus without touching the pituitary, and vice-versa, make it necessary to exercise caution in judging the experimental evidence. Experiments in which lesions of the hypothalamus were made by means of the Horsley-Clarke instrument and hypophysectomy experiments on rats seem to

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be the most reliable—the latter, because the operation method generally used for rats makes simultaneous hypothalamic lesions most unlikely.

It is not yet clear to what extent the growth hormone production of the pituitary anterior lobe depends on the hypothalamus. After transection of the stalk there was no impairment of growth either in rabbits (Brooks, 1938) or in male rats (Uotila, 1939). After inflicting lesions in different parts of the hypothalamus of rats by means of the Horsley-Clarke instrument, Hetherington and Ranson (1942) found some dwarfing in some of the animals.

There is ample evidence for the influence of the hypothalamus on the gonadotrophic function of the pituitary anterior lobe. Previous work (reviewed lately by Hartman, 1939) has shown that copulation in rabbits, which normally do not ovulate spontaneously, starts the process of ovulation, to be followed by luteinization and the formation of the pregravid uterus membrane. The whole process is conditioned by secretory impulses reaching the anterior lobe and giving rise to increased secretion of the gonadotrophic hormone; the response fails if the rabbit has first been hypophysectomized. Brooks (1940, review) claimed that following complete transection of the hypophysial stalk in the rabbit ovulation did not occur though the animals mated frequently. Histological examination of the hypophysis of these stalk-cut rabbits showed some changes in both eosinophil and basophil cells.

Brooks found also that the intravenous injection of copper salt which, according to Fevold, Hissaw and Greep (1936), produces ovulation in the rabbit, has no effect after transection of the stalk. Interruption of a possible alternative pathway in the greater superficial petrosal nerves does not disturb ovulation in rabbits (Vogt, 1942). In guinea-pigs, suppression of the oestrus cycle and genital atrophy have been observed by Dey (1942) after destruction of the median eminence or interruption of the connections with the hypothalamus. Dempsey (1939) published contradictory results.

Many results obtained after stalk transection in rats are still contradictory. Westman and Jacobsohn (1938) found genital atrophy after this operation, while Uotila (1940), Dempsey and Uotila (1940), Richter (1933) *et al.* report no changes. Richter, however, found the cycle prolonged. Uotila (1940) reported it to be normal after stalk-transection in rats, and unchanged after the rats had been put in a cold room. Normal control animals, when exposed to cold, showed prolonged dioestrus intervals and prolonged periods of cornification. Uotila suggests, therefore, that hypothalamico-hypophysial influence is only effective under certain environmental conditions. After lesions in the rostral part of the hypothalamic area of rats vaginal oestrus was persistent (Hetherington and Ranson, 1942), whilst animals with lesions in the under and caudal parts of the hypothalamus had normal oestrus cycles. Dey, Fisher, Berry and Ranson (1940) found after lesions of the anterior hypothalamus of female guinea-pigs disturbances of reproductive functions.

Brooks and Bard (1942) found in studies on monkeys that neither bilateral ablation of the stellate ganglia nor bilateral removal of the superior cervical ganglia, abdominal chains and coeliac ganglia abolished the rhythm of catamenia or the regular occurrence of signs of ovulation. In two immature monkeys transection of the hypophysial stalk with ablation of the lower

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portion of the tuber cinereum prevented sexual maturation. Three mature monkeys which had had normal cycles showed complete absence of cycles following similar lesions. In four mature females practically complete section of the hypophysial stem was accomplished. These animals, after several months during which menstruation did not occur, began to ovulate and menstruate regularly, although the cycles were 36 to 42 days in duration.

Sexual precocity associated with hyperplastic abnormalities of the tuber cinereum has been reported by Bronstein, Luhan and Mavrelis (1942). Weinberger and Grant (1941) describe cases of precocious puberty in which the hypothalamic region was involved. Several authors claim that the Lawrence-Moon-Biedl syndrome is due to hypothalamic abnormalities (Rathwell and Burns, 1938; Marmor and Lambert, 1938). Dott (1938) suggested that lesions about the mammillary bodies cause pubertas praecox because they cut out inhibitions and leave the opposing natural stimulative neurohypophysial mechanisms to operate unimpeded.

The relation of the hypothalamus to sexual behaviour has been recently reviewed by Bard (1940).

The production of lactogenic hormone by the pituitary seems also in some degree to depend on the regulatory influence of the hypothalamus. The existence of a neurohypophysial influence in the production of lactogenic hormone is generally admitted. This is primarily based on the fact that, in the rat, sucking reflexly affects the release of lactogenic hormone from the pituitary (Turner, 1939). After transection of the stalk, this neurohormonal mechanism seems to be interrupted (Herold, 1939).

Up to the present a direct secretory innervation of the thyroid was taken for granted. This assumption has proved to be utterly unfounded, since work with thyrotrophic hormone has shown that thyroids, though transplanted, denervated or even kept *in vitro*, can be stimulated directly by thyrotrophic hormone. At present, it can only be assumed (White and Smithwick, 1942) that the very complex vasomotor nerves of the glands regulate the escape of hormone in the blood and, perhaps, govern its production by regulation of the oxygen supply.

The pituitary-thyroid regulation works autonomously. The dependence of this mechanism on the hypothalamic centres is manifest when responses are evoked to environmental changes. According to Uotila (1939) the thyroid remains histologically normal after transection of the stalk. After subtotal thyroidectomy, compensatory hypertrophy of the remaining fragments occurs to an equal degree in stalk-cut and normal animals (Uotila, 1940).

The stimulation of the thyroid occurring normally on exposure to cold is prevented by stalk transection (Uotila, 1940). The thyroid follicles of stalk-sectioned rats which had been exposed to cold for several days failed to hypertrophy.

The relation between the pituitary anterior lobe and the hypothalamus in the production of corticotrophic hormone has not yet been closely investigated. The only fact recorded so far (Uotila, 1940) is that, unlike the thyroid, the adrenal cortex of stalk-cut rats hypertrophies following exposure of the animals to cold.

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There is still considerable confusion regarding the relation of the hypothalamus to fat metabolism and development of adiposity. It is partly due to the over-simplifying views of pathologists dealing with the so-called cerebral adiposity, partly to our rather limited knowledge of the hypophysial relation to fat metabolism (Reiss, review, 1939). In any case, it may be of use to base the pathophysiological analysis of stages of adiposity on the fact that there are hypo- and hyper-hypophysial forms of adiposity, and that destruction or stimulation of certain parts of the hypothalamus might cause either of them. Earlier literature is full of discrepancies. The only explanation for all these contradictory results—e.g. those of Smith, who produced adiposity by hypophysectomy and simultaneous impairment of the hypothalamus by chromic acid, of Camus and Roussy, Bailey and Bremer, and others, who described adiposity after tuber lesions, and of Ranson, Ingram and others, who could not find any adiposity after hypothalamic lesions of different kinds—seems to be the fact that the part played by the pituitary in fat metabolism was not known then, and the different lesions of the hypothalamus were not sufficiently localized. Bearing in mind these principles of pathophysiological analysis, one can easily expect the development of any symptom, adiposity, emaciation, no influence at all, adiposity combined with genital disturbances, adiposity without any genital disturbances, and so on, as the nature of the changes depends only on the circumscribed site of the lesion.

The introduction of the Horsley-Clarke instrument has eased the task considerably. In recently published experiments (Tepperman, Brobeck and Long, 1941; Hetherington and Ranson, 1942) distinct parts of the hypothalamus were damaged with the Horsley-Clarke instrument. Hetherington and Ranson found that obesity can be produced in rats by fairly symmetrical lesions which destroy bilaterally—

(1) Most of the ventromedial hypothalamic nuclei, together with some of the tissue immediately around them, especially on their lateral sides.

(2) The caudal ends of the ventromedial hypothalamic nuclei, the premammillary area, and a considerable part of the lateral hypothalamic areas adjacent to it.

(3) In the caudal hypothalamus the areas which lie dorsolateral to the mammillary body.

These pairs of lesions appear merely to represent interruptions at successive levels of paired systems (one on each side of the hypothalamus, and each one capable of acting more or less independently). Obesity is *not* produced in rats by lesions which destroy—

(1) The fornix bilaterally with small damage to surrounding tissue in the anterior hypothalamus.

(2) Large portions of the caudal halves of the anterior hypothalamic areas symmetrically.

(3) Most of the mammillary body.

(4) Most of one side of the hypothalamus.

(5) The midline structures in and close to the floor of the third ventricle, including the median eminence and the arcuate and suprachiasmatic nuclei.

The authors found further that the obesity might or might not be accom-

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panied by disturbances of the sex glands, and that apparently no significant correlation exists between the occurrence of adiposity and diabetes insipidus, the lesions which cause these stages being apparently fundamentally different. Other recent papers confirm that the obese condition due to hypothalamic lesions may occur associated with or without sexual disturbances, dwarfism or diabetes insipidus (Gagel, 1941; Brooks, Lambert and Bard, 1942). The results of Hetherington and Ranson make it clear that adiposity can also occur after destruction of hypothalamic nuclei which do not send any fibres to the hypothalamo-hypophysial tract. On this basis it becomes understandable why stalk transection is not bound to produce obesity and why, on the other hand, hypophysectomy closely following appropriate hypothalamic lesions does not prevent the appearance of typical obesity. The latter fact, moreover, proves the existence of a purely hypothalamic obesity which develops independently from the pituitary anterior lobe, and may or may not be based on a direct hypothalamic influence, on disturbed functions of the adrenal cortex, the gonads or other factors.

The relation of the hypothalamus to carbohydrate metabolism has been recently reviewed by Long (1940). As it is known that the carbohydrate metabolism is disturbed after hypophysectomy, and that the pituitary produces several hormones (thyreotrophic, corticotrophic, diabetogenic, and so on) which influence the carbohydrate metabolism, the existence of a regulatory influence of the hypothalamus may be postulated, though no direct evidence is as yet available. Previously published results on insulin hypersensitivity after hypothalamic lesions have not been confirmed by Brobeck, Magoun and Ranson (1939) in their recent investigations. In experiments carried out on large series of cats and monkeys these authors found insulin hypersensitivity only very rarely.

There is conclusive proof for the existence of the hypothalamic control of the posterior pituitary lobe. The extensive earlier literature on neurohormonal control of water balance has been reviewed by Fisher, Ingram and Ranson (1938). Interruption of the supraoptico-hypophysial tract is always followed by diabetes insipidus. The supraoptic nuclei atrophy, the posterior pituitary lobe becomes atrophic, and the pituicytes disappear. No antidiuretic, pressor or oxytocic substance is left in the posterior lobe. In a recent paper Heinbecker and White (1941) found after stalk transection diabetes insipidus in 150 dogs, and claim that diuresis was moderated if as little as 5 per cent. fibres were left intact, while failure to interrupt 15 per cent. of the fibres innervating the cells of the posterior lobe would prevent the development of polyuria entirely. These experiments may offer an explanation for earlier contradictory results. The authors showed further that the anterior lobe may not be necessary for the development and maintenance of a permanent state of diabetes insipidus. Even after its complete removal no interference with thirst and polyuria was noted. Polyuria only ceased in some operated animals in which infections in the region of the hypothalamus had occurred. Keller found recently (1942) that complete isolation of the pituitary from the hypothalamus by removal of the ventral tuberal portion of the hypothalamus failed to produce diabetes insipidus; nor did uncomplicated total hypophysectomy in dogs

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result in polyuria. Only total hypophysectomy combined with drastic infringements upon the hypothalamus was followed by continuous diabetes insipidus. The author assumes the existence of an extrahypophyseal antidiuretic elaborating mechanism. Hetherington and Ranson (1942) saw diabetes insipidus in rats after lesions in the rostral portion of the hypothalamus in the neighbourhood of the optic chiasma by means of the Horsley-Clarke instrument. Hickey, Hare and Hare (1941) found (in rats) diabetes insipidus after stalk transection. No antidiuretic substance could be found in the pituitaries of these rats.

Influence of the Higher Centres.

The level and type of activity of the anterior pituitary lobe and therefore, in a secondary way, of subordinate glands can be modified by influences reaching the organism through sense organs and traversing parts linked with the highest forms of mental and neural activity.

The nervous stimulation of the pituitary is particularly evident under different conditions of light, temperature and seasonal changes. Ferrets that were exposed daily during November and December for some hours to intensive illumination developed oestrus. This result was absent in hypophysectomized animals (Hill and Parkes, 1933). Clark, McKeown and Zuckerman (1939) made at the beginning of the non-breeding season lesions at various levels in the visual pathways of the brains of female ferrets. Afterwards the animals were exposed to 6½ hours of bright illumination at the end of each day so as to find out whether in this way oestrus could be produced in the anoestrus period. If the optic nerves of the ferrets had been divided the animals either never developed oestrus, or did so much later than the controls. The normal response to visual stimulation did occur, however, in the absence of the anterior corpora quadrigemina when all retinal impulses to the dorsal nucleus of the lateral geniculate body and the visual cortex were completely interrupted. It was suggested that the visual response depends on impulses passing either to the ventral nucleus of the lateral geniculate body, or to the subthalamus by way of the accessory optic tracts. The timing of ovarian function, follicular maturation and ovulation can be reversed in nocturnal animals, e.g. mice (Snell, Fekete, Hummel and Law, 1940). It is well known that increase of egg-laying in fowls through the winter can be induced by prolonged lighting time. Young drakes that were daily exposed to intense light developed precocious sexual maturity, and hypophysectomy inhibited this effect. The anterior lobe of such illuminated animals contained an excess of gonadotrophic hormone. If the animals were blindfolded the stimulating action of light was absent (Bissonnete, review, 1938). Blinding flashes of light stimulate the output of antidiuretic substance from the pituitary of frogs (Boyd and Young, 1940). This reaction did not take place if the eyes had been removed, the reflexes lost under anaesthesia or the brain destroyed by pithing. Pithing of the spinal cord, on the other hand, does not affect the reaction to optical stimuli. Transcerebral diathermy increased the production of antidiuretic substance in dogs (Michez, 1938).

In the human there is abundant evidence that psychic emotions which are accompanied by activities of the highest centres can influence even to a pathological degree the pituitary function. The influence takes the form of inhibition

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or depression. A commonplace observation is, in women, the frequent occurrence of amenorrhoea after fright or psychic shock, and, in men, the appearance of certain preclimacteric symptoms due to mental overstrain. Women suffering from personality disorders always show both, quantitatively and qualitatively, variations in their menstrual function. Reviewing 150 patients Allen (1935) found that a depressive mood, psychical depletion and motor underactivity are conducive to amenorrhoea, irrespective of whether or not the patient is delusional or hallucinated. An expansive, elated or ecstatic mood with good physical condition and motor overactivity predisposes to a profuse and prolonged menstrual period. The only explanation for changes of this kind is suggested by the fact that certain cortical centres are able to stimulate or inhibit the production of follicle stimulating and luteinizing hormone in the pituitary anterior lobe, through the mediation of the hypothalamus. It is probable that the production of all the other trophic hormones of the pituitary anterior lobe can be equally influenced by psychic emotions. This is particularly the case in anorexia nervosa, where amenorrhoea (lack of gonadotrophic hormone), atrophy of thyroid (lack of thyrotrophic hormone), emaciation and asthenia (lack of cortin and corticotrophic hormone) are combined. Reiss (1943) described a case of anorexia nervosa in which particular attention was drawn to the disturbed function of the pituitary. The patient, weighing at the start of the investigation 3 st. 12 lb., excreted in 24 hours 6 mgm. of the 17-ketosteroids and no traceable gonadotrophic or corticotrophic hormone. After change of environment, a full general diet and some psychotherapy the patient started gaining weight; ketosteroid as well as gonadotrophic and corticotrophic hormone excretion in the urine went up to a normal level; the patient seemed cured and was released from hospital. But in the following 3–5 months the patient continued putting on weight up to over 12 st., the ketosteroid excretion went up to 20 mgm. in 24 hours, and the fat distribution and general appearance of the patient suggested adiposity of the type seen in Cushing's syndrome. This case shows how pituitary anterior lobe function, once disordered by a nervous stimulus, can swing from one extreme to the opposite. Apart from this, the case would appear to justify the assumption that the so-called anorexia nervosa may exist as a cerebral form of pituitary cachexia. This pathophysiological conception of the anorexia nervosa syndrome may be paralleled by the distinction between cerebral and pituitary adiposity, and amenorrhoea due to cerebral damage and to hypopituitarism. Thus the syndrome of anorexia would, as in the case of pituitary cachexia, be due to the inability of the organism to metabolize food owing to the impaired production of the necessary anterior lobe hormones. It does not therefore seem to be necessary to go back to such fantastic interpretations of anorexia as that "one has a baby by eating," advanced by Waller, Kaufman and Deutsch (1940).

It has, of course, to be borne in mind that chronic inanition in rat experiments results in a generalized hypoplasia of the endocrine organs, which has been termed by Mulinos and Pomeranz (1940) "pseudo-hypophysectomy," because of the resemblance between the effects of inanition and those of hypophysectomy; see also Vollmer (1943). The patho-physiological analysis of

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anorexia nervosa seems to some extent complicated by the existence of a vicious circle, the primary cerebro-hypophysially conditioned anorexia producing by chronic inanition a further deterioration of the pituitary function. It is obvious that the interaction between cerebrum, pituitary and subordinate glands may nearly always proceed in a vicious circle. Primary psychic disturbances, affections or shocks may produce a disturbance in a gonadal function, and the gonadal affection may, in turn, affect cerebral activities. Such a circle of events may form the start of a pathological process, bound to grow worse and worse. This is, most probably, also the case in certain stages of schizophrenia.

Hemphill, MacLeod and Reiss (1942) saw a considerable increase in 17-ketosteroid output frequently follow electric convulsion therapy and prefrontal leucotomy. The greatest changes were seen where the original levels were low. It was assumed that the increased 17-ketosteroid output represents hyperactivity of the adrenal cortex due to increased production of corticotrophic hormone, since injection of corticotrophic hormone in cases of hypoadrenalism produced a similar increase in 17-ketosteroid excretion. It has been suggested that interference with nervous pathways between the frontal lobe and the hypothalamus may influence the pituitary to produce the same result.

One frequently observes the restoration of normal endocrinological appearance and function accompanying the cure of a severe psychosis. Such results are not infrequently seen to follow closely after prefrontal leucotomy. This would seem to indicate that interference with connections to the higher centres which alleviated an abnormal psychic condition, at the same time allowed the pituitary to resume its normal function.

The Influence of the Ductless Glands on the Brain Function.

In spite of the facts accumulated on the influence of normal and pathological endocrine function and hormones on brain function, the mechanism and precise physiological processes are barely understood. It is evident that where endocrine interferences produce alterations in brain function, they do so by primarily effecting a disturbance of brain metabolism with subsequent development of patho-physiological activity. So little is known about normal brain metabolism that the changes it may undergo under hormonal influence can be surmised. With the limited means of investigation at our disposal a general idea of the subject can best be obtained by considering the known data on the following: the influence exerted by the endocrines on brain metabolism, on cerebral circulation, on the reaction of the brain to stimuli and changes in the environment of the organism, on pattern of behaviour and on the relationship of glandular disturbances to mental and physical illness and the therapeutic effects of hormones.

These last two aspects, which are of a clinical rather than experimental interest, have been treated in another chapter by R. E. Hemphill.

Thyroid.

It is reasonable to suppose that the psychic phenomena and increased

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nervous activity of hyperthyroidism and the retardation of these processes in hypothyroidism result from a profound disturbance of brain metabolism. There are, however, only very few facts published on the matter. Cohen and Gerard (1937) treated rats for 16–19 days with thyroid powder and measured the respiratory activity of minced brain. The oxygen uptake was about 20 per cent. higher than normal, and was still further increased by adding glycogen, glycerophosphate, lactate or succinate. Apparently the various enzyme systems are more concentrated in the hyperthyreotic brain. MacLeod and Reiss (1940) investigated brain slices of normal and hypophysectomized rats after treatment with thyreotrophic hormone. In the hypophysectomized rats the O_2 consumption of the brain was increased 5–8 days after the commencement of treatment. The brain O_2 consumption of the normal rats was also increased, but much less markedly. This difference is due to the very characteristically increased thyroxine sensitivity of hypophysectomized animals (Reiss and Fischer-Popper, 1936). Oxygen uptake of brainbrei of thyroid-treated rats was increased, particularly if vitamin B_1 was given simultaneously. Addition *in vitro* of thyroglobulin but not of thyroxin increased the O_2 consumption (Rossiter, 1940). Spirtes (1941) found no significant changes in thyroid-fed guinea-pigs.

Ross and Schwab (1939) found that the cortical alpha rate as obtained by the electroencephalogram is low in myxoedema and returns to normal with the administration of thyroid. There is a good correlation between the alpha rate and the state of metabolism.

The effect of thyroxin on the social behaviour of hens has been studied by Allee, Collias and Beeman (1940).

In a recent review Lerman (1942) thus summarizes the action of the thyroid hormone on the nervous system: "The action of the thyroid on the nervous system is best observed in states of excess or of scarcity of the hormone. In the former case the person has emotional instability, increased irritability and sometimes gross disturbance in cerebration. In the latter case the person lives at a low emotional level, reacts sluggishly and cerebrates slowly; the memory is poor, and there is diminished sensory acuity. The effect of the thyroid on the vegetative nervous system is manifested by increase in vasomotor activity, peristaltic activity and activity of the sweat glands in thyroid intoxication and by the reverse of these phenomena in thyroid deprivation."

It has, of course, to be borne in mind that because of the well known antagonism of the thyroid to gonads and adrenal cortex, a primary disturbance of the first can cause secondary reactions of the latter.

Parathyroids.

No further investigations of the increased neuromuscular excitability dependent on hypocalcaemia have been carried out recently. Symmetrical calcification of brain tissue associated with parathyroid insufficiency has occasionally been found (Eaten and Haines, 1939). Albright (1942) saw the same condition in one case in which no symptoms referable to the central nervous system had been observed, and in another case in which there had been epileptic seizures.

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Considering the scarcity of biologically active parathyroid hormone, the therapeutic introduction of dihydrotachysterol during recent years has meant considerable progress in parathyroid therapy (Albright, 1939, and others).

Hyperparathyroidism gives rise to nerve and muscle reactions of a reverse nature to those of tetany. Just as hypocalcaemia causes increased neuromuscular excitability, so hypercalcaemia leads, according to Albright (1942), to decreased excitability. In patients with very high serum calcium there are certain symptoms, apparently due to the high serum calcium *per se*. The patients feel tired, lose weight and are constipated. According to Werner (1942) the excitability of peripheral nerves to electrical stimulation is greatly diminished.

Parathyroidectomized rats manifested increased appetite for foods with high calcium content and decreased appetite for such with high phosphorus content (Bodansky and Duff, 1941). Richter, Honeyman and Hunter (1940) investigated behaviour and mood cycles in parathyroid deficiency (in rats). In conditions where the maintenance of the normal blood calcium level is endangered, as in pregnancy and lactation, a very marked self-regulation develops. Pregnant and lactating rats, for instance, exhibit a craving for calcium (Richter, 1938). The curious, often observed phenomenon that growing and slightly rachitic children eat ashes may be similarly conditioned.

Thymus.

Although there is as yet little precise knowledge about the internal secretion of the thymus, the opinion that it exerts an influence on sexual behaviour is widely held. Bruner and Cunningham (1939) claim that sexual activity in female rats may be inhibited by injecting them with thymocrescin.

Pancreas.

There is no evidence that sugar combustion in the brain is disturbed in diabetic animals (Baker, Fazekas and Himwich, 1938). Sugar utilization and oxidation of brain are diminished in insulin-hypoglycaemic animals (Himwich *et al.*, 1937). Gellhorn *et al.* (1938) claimed that decreased oxidation produced by insulin is greater in brain than in other tissues. The immediate neurophysiological effect of insulin shock, metrazol epilepsy, continuous narcosis and therapeutic nitrogen inhalations has been attributed to cerebral anoxia (Gellhorn, 1938; Quastel, 1939; Himwich *et al.*, 1939/40). This point of view was opposed by Fraser and Reitman (1939).

Insulin shock treatment is dealt with in another part of this volume. With regard to insulin treatment only two points may be treated here on general lines because they are responsible for numerous misconceptions. The points in question are insulin hypersensitivity and insulin resistance. Both these stages depend primarily on the sugar storage in the body, and on the blood-sugar level. When the sugar stores are depleted, by, say, exhaustive work, hypoglycaemia is reached much sooner than under normal conditions. If, on the other hand, the sugar stores are continuously enriched, partly by feeding, partly by increased sugar fixation, insulin resistance may develop. After hypophysectomy, sugar oxidation is increased and the carbohydrate stores are

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very much diminished. Similar conditions prevail after adrenalectomy; therefore insulin hypersensitivity develops. The opposite phase is seen after treatment with the so-called glycotropic principle or adrenal cortex hormone and other procedures which fix sugar storage.

The diet selection of diabetic animals is of particular psychological interest (Richter and Schmidt, 1941). Diabetic rats manifested a marked appetite for fats and hardly any for carbohydrates; some ate large amounts of casein. All had an increased appetite for yeast. As long as the animals lived on this self-selected diet diabetic symptoms did not appear and they gained weight at practically the normal rate. When they returned to the normal diet, characteristic signs of diabetes were immediately observed.

Adrenal Cortex.

Considerable progress has been made in recent years in the isolation of about twenty crystalline adrenal cortex hormones and in the elucidation of the physiology of the adrenal cortex. Like the sex hormones, adrenal cortex hormones are all of steroid character and probably exert a far-reaching influence on brain function. Of that effect nothing definite is as yet known. Corticosterone and the so-called substance E are responsible for the adrenal cortical influence in the regulation of body temperature (Kendall, 1940).

The relationship of the adrenals to essential hypertension has been investigated by Raab (1941). Determination of the blood content of the adrenal hormonal compound, epinephrine and cortical steroids (adreno-cortical compounds), were carried out by the method of Shaw. A normal range was established, which did not vary much in normal controls. After muscular exercise the levels were only slightly increased. In essential hypertension they were also within normal range, but rose considerably after muscular exercise. Raab regards this as the decisive factor in the development of arteriosclerosis, and consequent ischaemia of the vasomotor centres.

The adrenals are involved in one of the most important self-regulatory mechanisms of the body, a disturbance of which produces salt hunger. It is well known that after removal of the adrenal gland sodium excretion increases excessively, causing profound changes in the body chemistry, with the appearance of grave symptoms and finally death. This catastrophe can be averted by adding large amounts of sodium chloride to the diet. Given access to sodium chloride, adrenalectomized animals ingest sufficiently large amounts to survive and to remain free from symptoms of insufficiency (Richter, 1942). Richter reports instances of this self-regulation in human beings. A boy, aged 3½, had, for over two years, eaten enormous amounts of salt. When restricted to a normal diet under observation he died within seven days, and it was found that a tumour in his adrenals had completely destroyed all cortex tissues. A 34-year-old sufferer from Addison's disease filled half of his glass of tomato juice with salt, so that, for him, the juice became a vehicle for the salt. He took salt also with grape fruit, oranges and lemons. Salt hunger seems to be a definite pathognomonic symptom of underfunction of the adrenal cortex and is, also in the experience of the author, of help in diagnosis. It has

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occasionally been observed in persons suffering from Simmonds' disease who added excessive salt to the little food they ate.

Adrenalectomized rats failed to differentiate between sodium chloride solution and water, and died as quickly as adrenalectomized rats without access to salt after section of the taste nerves (Richter, 1942). Clark and Clausen (1943) found that the increased salt intake after adrenalectomy returned again to the pre-adrenalectomy level after administration of desoxycorticosterone. Intake of protein, carbohydrate, fat and yeast remains unaffected by adrenalectomy.

The adreno-genital syndrome has been reviewed by Young (1937), Broster *et al.* (1938), Haymaker and Anderson (1938), Cahill (1938), and Wintersteiner (1942). The patho-physiological analysis of this syndrome and of the accompanying homosexual stages has made some progress since it has been known that the adrenal cortex can produce androgens and oestrogens, and that the androgen secretion can be increased by the corticotrophic hormone of the pituitary anterior lobe (Hemphill, MacLeod and Reiss, 1942). At least two androgens are produced by the adrenal cortex, the 17-ketosteroid, dehydroandrosterone, and the unsaturated triketone, adrenosterone. It is possible that at some stage of the body development the production of these hormones is increased as a result of environmental changes or some adequate internal stimulus, e.g. scarlet fever, which may affect the adrenal cortex. The author has seen different degrees of hirsutism, menstrual disturbances and adiposity in patients who had once suffered from scarlet fever, which may have been due to adrenal disturbances. Haymaker and Anderson (1938) believe the principal difference between Cushing's syndrome and the adreno-genital syndrome to be the overproduction in Cushing's disease of the cortical hormone with its action in maintaining the electrolytes and carbohydrate metabolism, and the overproduction of sex hormones in the adreno-genital syndrome.

The role played by the adrenals in psychosis is dealt with by Hemphill in this volume.

Gonads.

The cerebral circulation is apparently increased by sex hormones. Steinach (1936) showed that the blood content in the brain of castrated rats can be increased by administration of oestrone, using a not quantitative vital staining method. Reiss and Golla (1940) measured the blood content of the brain and found it considerably diminished after castration. After treatment with sex hormones the brain blood content of normal and castrated animals increased. There was no difference between the actions of oestrone and testosterone.

Dusser de Barenne and Gibbs (1943) have reviewed variations in the electroencephalogram during the menstrual cycle. Gibbs and Reid (1943) have found variations during pregnancy.

The role of the sex hormones in psychiatry has been reviewed by Reiss (1940). The following additional facts may be noted.

In an excellent review by Stone (1939) all behaviour patterns connected with sexual and reproductive function have been described. Recent experi-

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ments are, without exception, in agreement with the previous reports. Testosterone propionate administered to female canaries suppressed the female functions and behaviour, and initiated male traits: singing, courting of untreated females, peck-dominance (Shoemaker, 1939). Leonard (1939) noticed male singing in some females after as little as two days' treatment with 5 mgm. testosterone daily.

Female mating behaviour in rats after administration of testosterone propionate (Beach, 1941) is still unexplained, and may be due to degeneration of the testicles or simultaneous stimulation of the adrenal cortex. Salmon and Geist (1943) reported increase of libido in women after treatment with different testosterone preparations. This testosterone action was explained by increased susceptibility to psycho-sexual stimulation, increased sensitivity of the external genitalia and greater intensity of sexual gratification. It was suggested on the basis of these observations that endogenous androgens in the normal mature woman may act as the physiological sensitizer of both the psychic and somatic components of the sexual mechanism.

The therapeutic results achieved by testosterone in cases of enuresis in children (Schlutz and Anderson, 1943) may, if confirmed, throw new light on the pathogenic analysis of this behaviour.

Pituitary.

After hypophysectomy there is no significant decrease of oxygen consumption by brain slices, although liver slices of the same animal show this effect. There is an increase in anaerobic glycolysis of about 25 per cent. (MacLeod and Reiss, 1940).

It is obvious that hypophysectomy or administration of the different pituitary glandulotrophic hormones produced by the pituitary can give rise to most of the conditions detailed. Apart from these static modifications, the presence or absence of these organotrophic pituitary hormones may lead to highly complicated variations of behaviour. These observations are to some extent consonant with claims made to have demonstrated an infection of the pituitary fossa from the sphenoidal sinus as a causal factor in some psychoses (Graves and Pickworth, 1941).

Rats show, after hypophysectomy, an increased drive for nest-building. According to Richter (1942) their thermoregulation is disturbed and they make, therefore, an effort to conserve their normal body temperature by building large thick nests. He compares this activity with the behaviour of rats which, after removal of the posterior lobe, have lost their physiological means of maintaining a constant water balance and compensate by drinking large amounts of water.

Riddle *et al.* (1942) recently studied endocrine conditions of maternal behaviour on the results of several thousands of tests. They found that among the pituitary anterior lobe hormones prolactin is the most effective in producing maternal behaviour, but follicle-stimulating hormone terminates it, even when well established. The authors found further the very interesting fact that every kind of treatment which exerts an antigonad action can, to a certain extent,

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produce maternal behaviour. Hypophysectomy alone precipitates maternal behaviour in approximately 50 per cent. of otherwise intact rats; progesterone, desoxycorticosterone and testosterone have a similar effect to prolactin.

Chadwick (1940) investigated the water drive of *Triturus*, and found that pituitary anterior lobe extracts which contained growth hormone caused normal and hypophysectomized efts to enter water within five days after commencement of the injections.

Masculinization has been observed in newborn female rats after treatment with gonadotrophic pituitary extract (Bradbury and Gaensbauer, 1939; Greene and Burrill, 1939). It is assumed that this extraordinary reaction, which, of course, disappears after a few weeks, is due to the occurrence of early luteinization, since androgenic properties of progesterone are known (Greene and Burrill, 1939, and others). The results of these animal experiments may supply a new approach to the pathophysiological analysis of certain forms of homosexuality. Further progress in the investigation of the interrelationship of oestrone, progesterone, pregnandiol and testosterone in the body fluids may point to causes of homsexual aberration which, at present, are treated on psychological lines only.

Hemphill, Reiss and Taylor (1943) found in schizophrenics a disturbance of the testicle structure similar, in certain aspects, to the degenerative features of testicles in hypophysectomized rats. The earlier observations of Mott are thus in some degree confirmed.

The blood content of the rat brain, which is considerably decreased after hypophysectomy, increases after administration of gonadotrophic hormones in young animals, and is higher during oestrus than in the anoestrus phase (Reiss and Golla, 1940). According to Gillespie (1940), it is conceivable that alteration in the mental state of a depression corresponding with the phases of a menstrual cycle may be connected with a state of cerebral circulation.

Increased appetite and the pathological syndrome of overeating and greediness are possibly connected with changes of the pituitary anterior lobe function. After treatment of emaciated involutional melancholics with corticotrophic hormone return of an ever increasing desire for food was the first effect to be seen (Hemphill and Reiss, 1942). The loss of appetite in morbus Simmonds could be explained as an instance of self-regulatory behaviour. Hypophysectomized animals eat less because the lack of growth hormone is responsible for the absence of the specific dynamic action of proteins (Reiss, 1940), and lack of corticotrophic and, consequently, of adrenalcortical hormone is responsible for the disturbance of the fat metabolism. Excessive ingestion of food would lead to the appearance of toxic symptoms in hypophysectomized animals. Patients suffering from the Cushing's syndrome, on the other hand, have very often an increased appetite. An inhibiting centre is most probably in the frontal lobe. Appetite is increased after prefrontal leucotomy. After destruction of the tips of the frontal brain poles rats may eat almost incessantly (Richter and Hawkes, 1939; Beach, 1941). Also after lesions in the thalamus rats or monkeys eat excessively and become obese (Hetherington, 1941).

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MENTAL TESTING.

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I. Introduction.

Increased use of mental tests for the study of psychoses and allied disorders is conspicuous in recent psychiatric practice. This increase is most prominent first in the use of Rorschach's ink-blots; second, in the investigation of conceptual thinking with methods originated by Goldstein; third, in the study of psychometric pattern; fourth, in the diagnosis and measurement of intellectual deterioration; fifth, in assessing prognosis and the effects of treatment. It is partially attributable to sharpening of interest, due to the war, in the prediction of break-down under stress, in the stability and social potentialities of border-line groups, and in estimating the effects of head injury. Another factor is that popular modern treatments such as shock therapy and prefrontal leucotomy appear to involve cerebral areas intimately associated with intelligence. The greatest advances, however, have been made by the followers of Rorschach and of Goldstein and their contributions began before these factors arose. Their methods are also much applied in investigations under the fourth and fifth headings. Their influence, too, is discernible in a change now developing in the way of using mental tests. Whereas in most early investigations tests were used quantitatively as instruments for studying how intelligence level affects and is affected by psychosis, the modern tendency is to use tests not as measuring instruments, but as standard interviews or situations in which the quality rather than the level of the subject's behaviour is studied. On the other hand, perhaps it was growing recognition of the unsuitability of most quantitative tests for application to adults, and of the additional difficulties of interpreting results in psychoses, that first induced search for other techniques.

II. Tests and Scales.

Tests are currently used for investigating general intelligence, intellectual deterioration, conceptual thinking, and character and personality.

Tests of general intelligence.—Chief of these is the revised Stanford Binet scale. The new features are extension in range upwards and downwards, calculation of the I.Q. with a denominator of C.A. 15 instead of 16, and appearance in two equivalent forms, L and M. It still has many disadvantages. It is still, as Cattell (1940) scathingly says, a "hotch-potch." The ingredients are different at different levels of the same version, and at the same level of

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different versions. Its administration to adults is a long and tedious business. The content of the items is often too childish or too gruesome (Krugman, 1939) to be suitable for adults and abnormal subjects. Its abbreviated vocabulary test appears to exaggerate mental age (Atwell, 1939; Brody, 1940). Nevertheless, its great prestige will ensure wide application.

Wechsler's Bellevue scale (1941) is rapidly gaining popularity. It consists of a battery of five verbal tests—comprehension, information, digit span forwards and reversed, arithmetical reasoning and similarities—and of five performance tests—picture arrangement, picture completion, object assembly, block design, and digit symbol. Intelligence quotients can be calculated for the total battery and for each half. Quotients are moreover calculated with a different denominator for different age-groups, thus allowing for normal decrement after adolescence. Such batteries are superior to scales of the Stanford Binet type for investigating psychometric pattern and for comparing persons of different ages.

Penrose and Raven's "Progressive Matrices" is a non-verbal intelligence test now widely used (Raven, 1942), and too familiar to need description. A disadvantage, common to all paper-and-pencil tests, is that the cause of failure in psychosis is not directly evident.

Among rapid tests of general intelligence those described by Brody (1940), Esher (1941), Hayman (1942), Kent (1942) and Trist (1941) may be recommended.

Measures of intellectual deterioration.—Babcock's test is the best known of these, and provided the pattern for others. The first part of the test, the 1916 Stanford Binet vocabulary test, is claimed to measure the patient's pre-morbid intelligence level. The second part tests the patient's effective ability in numerous traits. Norms for Part II are available for each vocabulary level. The index is calculated by subtracting the patient's average score in Part II from the norm for his vocabulary level. Part II of the 1930 version has 30 items, of which 20 are used in the 1933 version. Babcock and Levy again revised the scale in 1940. Brody's "Discrepancy Score" (1942*b*) is the percentage discrepancy between vocabulary norm and average score on five Babcock items. Discrepancy between score on vocabulary and on other tests, for example, a vocabulary-free Stanford Binet scale, has been similarly employed. Shipley's Hartford test (Pollock, 1942) employs the same principle in a paper-and-pencil form. Part I is a 40-item multiple choice vocabulary test. Part II contains 20 mixed items of the series-completion type claimed to test abstraction (e.g. mist is . . . wasp as . . . pint in . . . tone . . .). A limit of ten minutes is set for each half. The percentage of the score on Part I obtained in Part II is called the "Conceptual Quotient."

Hayman (1942) has adapted serial subtraction of 7 from 100 as a test of intellectual deterioration.

Tests of conceptual thinking.—Goldstein himself with Scheerer (1941) has described five of these. In two, a modified Kohs block-design and the "Stick Test," patterns are to be copied with coloured cubes and orange sticks. The task in the other three is sorting—of coloured wools, of cardboard discs which can be grouped as to colour or shape (the Weigl test), and of objects which can

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be grouped as to shape, colour, material or use. Another favourite is Hanfmann and Kasanin's (1942) modification of the Vigotsky test. The material consists of blocks of various shape, size and colour, but classifiable into four categories designated by nonsense names. The task is, by achieving the fourfold grouping, to arrive at the "meaning" of the nonsense names. Many verbal items, interpretation of fables for example, also test conceptual thinking.

Tests of character and personality.—These are considered in Section XII.

III. Reviews.

Blackburn (1938) and Brody (1942*a*) have published surveys of the literature. The former reviews methods, the latter results. Brody includes a résumé of investigations on normal changes in mental test ability from adolescence to senility, to which the results in psychosis are referred. Kendig and Richmond (1940) and Roe and Shakow (1942) mention most of the important previous investigations. Excellent reference books have been published by Buros (1938, 1940) and Greene (1941).

IV. Validity.

Has this individual failed because he is deficient in the specific function investigated by the test, or because he cannot react normally to the "piece of life" which the test session, so to speak, constitutes? This doubt overhangs the validity of all conclusions, based on test results, about the "intelligence" of abnormal persons. Even though the subject has displayed during the tests his maximum co-operation, attention, effort, equanimity and so on, these may remain below levels necessary for validation. Wittman, realizing this, has devised the Elgin Test Reactions Scale (Wittman and Russell, 1942) whereby such factors can be rated. Significant here is Layman's report (1940) that increased rapport achieved by intravenous sodium amytal in schizophrenia is accompanied by improved test performance.

Roe and Shakow (1942) compared Stanford Binet records in "representative" and "non-representative" patients. A patient was deemed "representative" if his performance was thought to be his best. In all diagnostic groups the former surpass the latter, "but the effect of attitude seems to be by far the greatest in the hebephrenic group, with the catatonic and paranoid groups following. It is least in the psychopathic personality, unclassified praecox and manic-depressive groups. These results may be interpreted to mean either that in some diagnostic groups attitude affects cognition less than it does in others, or that in these the quality of representativeness is more difficult to judge. Both factors seem to be involved but in different degrees." The differences between the groups were less than those between representative and normal groups. Thus, the effect of psychosis is greater than that of attitude; but—an important point—the pattern of their effects is essentially similar.

V. Premorbid Intelligence in Relation to Psychosis.

Test results.—Whether psychoses in general or particular appear at certain mental levels rather than at others is a problem of perennial interest. Test results

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in psychosis are rarely valid measures of intelligence. But the range of levels in Roe and Shakow's groups was so wide that it seemed "a potent argument against a belief that original level of intelligence may determine in any substantial part the type of psychosis." In contrast, a graph prepared by Atwell (see Epstein and Solomon, 1939) of the I.Q. distribution of large numbers of recent patients shows the 50th percentile cutting I.Q. 78 as compared with I.Q. 87 for the American Army white draft. The results of Collins *et al.* (1938) suggested that epilepsy particularly attacks the feeble-minded. According to Trowbridge *et al.* (1939) alcoholism occurs in persons who, as a group, "may be classed as dull, but certainly not feeble-minded." Vocabulary level is the best, though not infallible, test indicator of pre-morbid intelligence, but has not been used in the present problem.

Educational levels.—Educational levels have been investigated by Roe and Shakow (1942) and by Kendig and Richmond (1940). Of the former's groups only the catatonics significantly differed from normal, having had almost two years more schooling. The latter, however, report that 76 per cent. of their 500 schizophrenics were retarded at school. The quality of school work was "poor" in 41 per cent. of cases, the catatonic and paranoid types having had the best records. The hebephrenics had the highest percentage (20 per cent.) to reach college level. Either schizophrenia, they conclude, or the factors precipitating it occur early enough to encroach on the school period, or the malady chiefly affects persons of poor endowment.

Psychosis and mental defect.—Rosanoff (1938) quotes figures showing that psychoses are common in oligophrenia. Mental defectives with psychosis constitute 3·5 per cent. of the total population in New York State Hospitals, and about 2·2 per cent. of first admissions. Kallman *et al.* (1941), however, after studying the taint conditions in the kinships and twin partners of schizophrenics and mental defectives, find no correlation between the two conditions.

A new method.—Sufficient time has now elapsed for obtaining relevant information by following up children and adolescents tested in the early days of standardized scales. This method offers the best chance of solving this problem. Gardner (1940) has made a promising start. The 22 psychotic patients he discovered in a follow-up of 3,500 children had been normal in intelligence. Terman (1940), more interested in the fate of his group than the present problem, reports, incidentally, that highly gifted children, examined after an interval of 16 years, had a lower insanity rate than others of their age.

VI. Intelligence Level in Psychosis.

Few researches are now undertaken simply to measure "intelligence level" in psychosis. Test results are rarely valid indicators of premorbid capacity; and other methods have now been evolved for investigating intellectual deterioration.

Mental ages, or their equivalents, in various syndromes are included in papers by Babcock (1941), and Roe and Shakow (1942); in schizophrenia, by Kendig and Richmond (1940), and Chase (1941); in drug addiction by Hall (1938), Pescor (1938), and Brown and Partington (1942*a* and *b*); and in

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epilepsy by Collins *et al.* (1938). On the whole the results are in agreement, and support other evidence of the important effects of faulty test reaction. Groups such as psychoneurotics, drug addicts, manic-depressives in remission and paraphrenics consistently approach normal. Paretics and epileptics score poorly, with mental ages usually about 11. Results in schizophrenia vary between these levels, paranoid excelling hebephrenic types.

VII. Psychometric Pattern.

The disposition of an individual's relative success in different kinds of tests or in the items of a composite scale is termed his psychometric pattern. Many attempts are now being made to discover specific psychometric patterns in psychosis as a whole and in the various diagnostic groups.

Vocabulary preservation.—An early observation was that vocabulary ability is usually well preserved in psychosis. Many modern researches confirm this. Good testimony is the popularity of Babcock's technique for measuring dementia, since its validity depends on vocabulary preservation. Davidson (1939) and Roe and Shakow (1942) found vocabulary superior to Stanford Binet scores. Jastak (1939) and Bijou (1939, 1942*a* and *b*) regard vocabulary supremacy as a hallmark of mental abnormality. Wechsler (1941*a*) and Magaret (1942) report vocabulary supremacy in psychotic performance of the Bellevue scale. Penrose and Myers' patients (1941) achieved their best performance in vocabulary (see Graph II). The frequency of better performance in psychosis on verbal than on non-verbal tests is partially attributable to the prominence of vocabulary and similar items in verbal scales.

Nevertheless evidence is now accumulating which throws doubt on both the specificity and universality of this vocabulary superiority. By listing the vocabulary-Stanford Binet discrepancy according to age, Roe and Shakow convincingly demonstrate that vocabulary superiority increases with increasing age, irrespective of psychosis or normality. Brody's survey (1942*a*) led to a similar conclusion. Capps (1939) and Gottschalk (1942) both report almost zero Babcock indices in their most deteriorated epileptics, proving that vocabulary had declined to the general level. The schizophrenics studied by Kendig and Richmond and by Chase scored on vocabulary little better than on the whole Stanford Binet scale. Shakow *et al.* (1941) found in senile and arterio sclerotic patients a vocabulary failure absent in normal persons of the same age. The hebephrenic and paretic subjects of Roe and Shakow scored 28 and 16 M.A. months below the levels expected from their educational histories. Brody (1942*c*) found that vocabulary score itself decreased with increasing dementia, partially explicable, he believes, by *earlier* as well as greater vocabulary deterioration than has hitherto been supposed.

Verbal-non-verbal pattern.—Jastak's pattern, vocabulary highest, verbal scale next, non-verbal scale lowest, is believed by Bijou to be so characteristic of abnormality that he suggests (1942*b*) its use by medical boards for the prediction of breakdown. Earl (1940) also attaches importance to verbal over non-verbal superiority. He found that the prognosis for morons was good in those who scored better on Kohs blocks and a modified Dearborn formboard than on

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vocabulary and verbal absurdities, and poor in those with the reverse pattern. Wechsler found better performance on the verbal than on the non-verbal half of his scale in "organic brain disease, psychosis and psychoneurosis." In the same scale, verbal preponderance is displayed in schizophrenia (Rabin, 1942*a*, Mitchell, 1942) and depression. Epileptics investigated by Somerfeld-Ziskind and Ziskind (1940) scored below their Stanford Binet mental age on the Goodenough drawing and Knox cube tests. In two investigations of children inadequacy on non-verbal tests accompanied abnormality. According to Bender (1940), children with post-encephalitic behaviour disorders exhibited specific disability in the Goodenough drawing test. Lord and Wood (1942) invariably discovered evidence of cerebral damage in children who, in comparison with their performance in verbal tests, scored poorly in a designs from memory test, the Ellis Visual Designs test. It should be noted that the designs from memory and ball-and-field items usually included in verbal scales and regularly found to be difficult for psychotic subjects are essentially non-verbal in type.

Some investigations, however, have failed to reveal this pattern of verbal over non-verbal test superiority. Gilliland (1941) discovered no significant differences in this respect between the Wechsler patterns of psychotic and normal subjects. Brown and Partington (1942*a* and *b*) made a similar comparison, with negative results, between narcotic drug addicts and normals. Sixty patients tested by Benton *et al.* (1941) had mean I.Q.'s of 105 and 99 for the verbal and non-verbal of the same scale, the difference being statistically insignificant. Rabin (1941, 1942*a* and *b*) and Wechsler himself (1941*a*) found no verbal supremacy in manic-depressive and psychoneurotic patients, and in psychopathic personalities and mental defectives. Arluck's (1941) 16 epileptics showed insignificant differences between performance on verbal tests and Porteous mazes. Brody (1942*c*) found that verbal superiority, though present in slight, was absent in more severe dementia, wherein there is a general levelling down of abilities.

Stanford Binet pattern.—Many attempts have been made to discover Stanford Binet patterns typical of diagnostic groups. Malamud and Palmer (1938) evolved schizophrenic and organic patterns from the analyses of the performance of 100 patients of each type. The organic pattern is composed of successes on years X, XII and XIV vocabulary and on year XIV "differences between president and king"; and of failures on "counting backwards from 20 to 1," "weights," "4 and 5 digits reversed," "three words in a sentence," year X "absurdities," "free association for three minutes," and "date." The schizophrenic pattern is composed of successes as in the organic pattern with additional success on year XIV "arithmetic"; and of failures in years VIII and X "comprehension," "date," "weights," "three words in a sentence," year X "absurdities," "free association for three minutes," year XII "picture interpretation" and "problems of fact." As can be seen, the patterns are similar, especially in the successes, which are mainly in vocabulary. Collins *et al.* (1938) applied the Stanford Binet scale to 229 epileptics whose M.A. range was 2–6 to 18–0 with the median at 10–5. Notably common failures below average adult level were on "ball-and-field"

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both plans, "weights," "4 digits reversed," "6 digits forward," "rhymes," "immediate memory for paragraph," and especially "designs from memory." At the upper levels, tests often passed above M.A. were "induction," "problems of fact," and "enclosed boxes." On comparing these patients with 249 paretics and 210 schizophrenics, Collins (1939) concluded that the pattern was "of deterioration and memory failure in the paretic, of apathy and thinking disturbance in the schizophrenic, and non-psychotic in the epileptic." In 1941 she again failed to find a specific pattern in epilepsy. Somerfeld-Ziskind and Ziskind (1940) and Arluck (1941) had similar results in epilepsy. Whereas Kendig and Richmond found little to differentiate the patterns in the four types of schizophrenia, Roe and Shakow discovered differences on almost every item. In schizophrenia as a whole, however, their results agree. Kendig and Richmond divide the items notably failed by schizophrenics into two groups, as follows:

Mainly Eductive.

Fables: XII–5 and XVI–2.
Abstract words: XII–2 and XVI–3.
Vocabulary: XIV–1.
Induction: XIV–2.
Problems of fact: XIV–4.
Ball-and-field: VIII–1 and XII–3.
Dissected sentences: XII–4.
Pictures: VII–2 and XII–7.
Absurdities: X–2.
Comprehension: X–5.
Differences: VII–5.
Similarities: XII–8.

} This includes all items classed by Roe and Shakow as conceptual and associative thinking, except XVI–4, XVI–6 and XIV–6, and also all vocabulary and definition items.

Mainly Non-eductive.

Digits forward: VII–3, X–Alt. and XIV–Alt.
" reversed: IX–4.
Designs: X–3.
Reading and report: X–4.
60 words: X–6.
Date: IX–1.
Weights: IX–2.
Syllables: VI–6.

Roe and Shakow group the Stanford Binet items into four classes (Table I). Their summary of the pattern in many syndromes appears in Table II. Apart from the vocabulary preservation already mentioned, they were impressed by the "consistency with which repetition of digits forward was affected. . . . In general, the severer the clinical manifestations of the disorder, the more marked the impairment of this test"; but whether due to disturbance of memory or of the span of attention, they were unable to decide. Analysis showed that items "primarily affected are of the conceptual thinking and immediate memory group, and . . . those least affected are old learning items."

Roe and Shakow also compared similar disorders. In chronic alcoholism with and without psychosis and in acute alcoholic psychosis, the pattern was similar although general level was superior in the last group. Psychopaths with and without psychosis were very close, with, however, more variability in the latter. This group closely resembled the psychoneurotic but was significantly inferior at interpreting pictures and the clock test. Paraphrenics were

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TABLE I.—*Classification of Stanford-Binet Items (Roe and Shakow, 1942).*

Year level.	Remotely learned—vocabulary (LRV).	Remotely learned—other types (LRO).	Immediately learned (LI)	Associative thinking—immediate (TAI).	Associative thinking—sustained (TAS).	Conceptual thinking (TC).
VI	..	1. R. and L. 3. 13 Pennies 5. Coins	6. Syll. (16)	2. Mut. Pic. 4. Compr.	..	..
VII	..	1. Fingers 4. Bow knot 7. Days week	3. 5DF 8. 3DB	2. Pic. des.	...	5. Diff.
VIII	5. Defin. 6. Vocab. (20)	2. 20–0 7. Coins	..	3. Compr.	1. B. and F.	4. Simil.
IX	..	1. Date 7. Months	4. 4DB	3. Change	5. Sen. cons. 6. Rhymes	..
X	1. Vocab. (30)	..	3. Designs 4. Rd. and rep. 7. 6DF 8. Syll. (20)	5. Compr.	..	2. Absurd.
XII	1. Vocab. (40) 2. Abst. words	..	6. 5DB	7. Pic. intp.	3. B. and F. 4. Diss. sent.	5. Fables. 8. Simil.
XIV	1. Vocab. (50)	..	7. 7DF	..	5. Ar. reas. 6. Clock	2. Induct. 3. Pres. and king. 4. Prob. fact.
XVI	1. Vocab. (65)	..	5. 6DB 7. Syll. (28)	..	4. Encl. box 6. Code	2. Fables. 3. Abs. words.
XVIII	1. Vocab. (75)	..	3. 8DF 4. Thought 5. 7DB	..	2. Paper cut 6. Ingenuity	..

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TABLE II.—*Types of Items Affected in Representative Groups (Roe and Shakow, 1942).*

	LRO.	VOC.	TAL.	TAS.	LI.	TC.	No. +.
General paresis	+	+	+	+	++	++	8
Chronic alcoholism δ psychosis	o	+	o	+	+	+	4
,, ,, s psychosis	o	o	o	o	o	+	1
Acute alcoholic psychosis	o	o	o	o	o	o	o
Paranoid DP	o	+	+	o	+	++	5
Hebephrenic DP	+	++	++	++	++	++	11
Catatonic DP	o	o	o	o	o	+	1
Simple DP	o	o	+	o	+	+	3
Unclassified DP	+	+	+	+	+	++	7
Manic-depressive	o	o	o	o	o	o	o
Psychopathic personality δ psychosis	o	o	o	+	o	+	2
,, ,, s psychosis	o	o	o	o	o	o	o
Paranoid condition	o	o	o	o	+	o	1
Psychoneurosis	o	o	o	o	o	o	o
Without psychosis	o	+	+	+	+	+	5
Number of groups with + or ++	3	6	6	6	8	10	..
Total number +	3	7	7	7	10	14	48

o = None; + = 1–40 per cent.; ++ = 41 per cent. above.

consistently superior to paranoid schizophrenics, though statistically, only the difference in absurdities at X–2 approached significance. Catatonic and manic-depressive patients were indistinguishable in both total performance and item analysis. Chronic psychotic alcoholics surpassed paretics in total performance and in similarities, induction, 4 digits backwards and 6 digits forward. Paretics surpassed both psychotic and non-psychotic simpletons in mean score and in many items. They were, however, differentiated from the hebephrenics (Graph I) by only one sign—superiority in XII–2 differences between abstract words. This important result is confirmed by the similarity in Wechsler pattern between Magaret's (1942) schizophrenic and paretic patients.

Brody (1942*c*) investigated psychometric pattern in dementia with form L of the revised Stanford Binet scale. He summarized his chief findings as follows:

Item.	Significance.
Below year VII Similarities and differences (year VIII)	Failure uncommon but always indicative of serious dementia if vocabulary is within normal range.
Memory for designs (year IX) Reading and report (year X) Copying bead chain (year XIII) Picture absurdities (year XIV) Orientation (year XIV) Codes (A.A.) Ingenuity (A.A.) Essential similarities (S.A. 1) Enclosed boxes (S.A. 1)	Failure below vocabulary age almost always present in serious dementia, but not necessarily proof thereof, since many normal persons also fail here. Success strongly argues against the presence of serious dementia.
Verbal absurdities (year VIII) Memory for stories (year VIII) Memory for sentences (year VIII) Paper cutting (year IX) Rhymes (year IX) Dissected sentences (year XIII)	Failure below vocabulary age present in at least 50 per cent. of seriously demented patients, and usually indicative of serious dementia.
Finding reasons (year X)	Failure below vocabulary age as above, and almost always indicative of serious dementia.

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TABLE III.—*"Pattern" of Psychotic Test Performance (Penrose and Myers, 1941).*

"General Examination M."
Relative Difficulty of Sub-tests for Psychotic Subjects.

Sub-test.*	Relatively easy.	Mean standard score. Non-psychotic. N. 293.	Psychotic N. 40.
V.	Vocabulary	10	9·3
No. 2	Picture assembly	10	8·8
No. 9	Same—opposite	10	8·1
No. 7	Arithmetic problems	10	8·0
	Relatively hard.		
No. 6	Mechanical information	10	5·7
No. 8	Absurdities (verbal)	10	5·5
No. 1	Picture completion	10	4·9
No. 3	Absurdities (picture)	10	4·7

Revised Stanford-Binet (Form L).
Relative Difficulty of Items for Schizophrenic Subjects.

Number of year levels at which item appeared.	Relatively easy.	Average weighted score value.†
9	Vocabulary	+ 35
4	Abstract words	+ 12
3	Memory for sentences	+ 10
7	Repeating digits	+ 10
	Relatively hard.	
4	Absurdities (verbal)	− 15
3	Memory for stories	− 21
3	Absurdities (picture)	− 28
4	Memory for designs	− 29

* Sub-tests Nos. 4, 5 and 11 are omitted because they were found to be of neutral difficulty, i.e. neither relatively "easy" nor relatively "hard" for psychotic subjects.

† Weight based on comparison of 100 schizophrenic and 100 non-psychotic subjects (matched for M.A.). Each item was compared to other items in the same year level in respect to per cent. passing.

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TABLE IV.—*Test Characteristics of Various Clinical Groups (Wechsler, 1941).*

A. Organic brain disease.

1. Verbal higher than performance.
2. Information: Relatively good.
3. Comprehension: Relatively good.
4. Arithmetic: Poor.
5. Similarities: Poor.
6. Memory span: Very poor, particularly digits backwards.
7. Block design: Very poor.
8. Object assembly: Poor.
9. Digit symbol: Very poor.
10. Small variability when verbal and performance test scores are considered separately.

B. Schizophrenia.

1. Verbal higher than performance.
2. Information: Good.
3. Vocabulary: High.
4. Comprehension: Generally good but occasionally poor.
5. Arithmetic: Poor.
6. Memory span: Unpredictable; usually high on digits forwards, often poor on digits backwards and generally poor when taken together.
7. Similarities: Low (paranoid).
8. Picture arrangement: Low in certain types of paranoids.
9. Picture completion: Low in hebephrenics and relatively high in simple schizophrenics.
10. Digit symbol: Low.
11. Block design: Better than object assembly.
12. Large intertest discrepancies.

C. Psychopathic personality (adolescents).

1. Performance higher than verbal.
2. Object assembly: High.
3. Information: High.
4. Comprehension: Unpredictable.
5. Arithmetic: Poor.
6. Similarities: Poor.
7. Picture arrangement: Relatively good.
8. Picture completion: Frequently poor.
9. Sum of block design and picture completion test scores nearly always less than sum of object assembly and picture arrangement test scores.
10. Intertest variability: Moderate.

D. Neurotics.

1. Verbal higher than performance.
2. Vocabulary: High.
3. Information: Good.
4. Arithmetic: Unpredictable, but generally poor.
5. Digit span: Generally poor, frequently showing no difference between number of digits repeated correctly forwards and number repeated correctly backwards; sometimes better on digits backwards than on digits forwards.
6. Similarities: Relatively good.
7. Object assembly: Low.
8. Digit symbol: Generally low, but with some exceptions.
9. Interest variability: Unpredictable but generally less than schizophrenics.

Attempts, however, to categorize these items failed. No distinctive types of mental test differentiated non-demented, slightly, moderately and seriously demented subjects. Font (1940) also used the revised version. Although the published summary of his paper gives no details, he claimed that certain responses were typical of schizophrenia. Penrose and Myers (1941) compared the psychometric patterns of psychotic and neurotic subjects in General Examination—M of the Canadian Psychological Association and in the Stanford Binet scale with that of recruits. In both tests, the easy and difficult items were of the same kind (Table III). They claimed that 75 per cent. of abnormal cases could be recognized by the pattern in General Examination M.

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Wechsler pattern.—Wechsler's own large experience led him to beliefs summarized in Table IV. Elsewhere (1941*b*) he noted specific failure amongst heavy drinkers without psychosis or signs of cerebral involvement, in the similarities and digit-symbol items of his scale, suggesting that capacity for logical analysis and organization is affected more than memory. The pattern discovered by Rabin (1941, 1942*a*) in manic-depressive psychosis and schizophrenia is shown in Table V. Rabin believes that the index $\frac{\text{Inf.} + \text{Comp.} + \text{Block design}}{\text{Dig.-Symb.} + \text{Obj. Ass.} + \text{Sim.}}$ is useful for diagnosing schizophrenia. Indices in various groups were nurses, 0·98; manic-depressive psychosis, 1·08; psychopathic personality, 1·08; psychoneurosis, 1·09; schizophrenia, 1·27. On comparing senile and arterio-

TABLE V.—*Rank Order of Wechsler Subtests in Psychosis* (*Rabin*, 1941, 1942*a*).

Item.	28 Manic-depressives.	76 Schizophrenics.	92 Normals.
Information	1	1	7
Comprehension	2	2	2
Arithmetic	8	3·5	10
Digits	9	7·5	9
Similarities	4·5	5	5·5
Picture completion	6·5	7·5	8
Picture arrangement	6·5	9	5·5
Object assembly	4·5	6	3
Block design	3	3·5	4
Digit symbol	10	10	1

sclerotic dements (1942*b*), he found that age particularly affects performance in object assembly and picture completion, and arteriosclerosis in digits and arithmetic, while leaving conceptual approach to the similarities and block design items relatively unimpaired. The schizophrenic pattern described by Magaret (1942) differed not only from the normal pattern, but also from the schizophrenic patterns described by both Rabin and Wechsler.

In contrast, Gilliland (1941) and Brown and Partington (1942*a* and *b*) could find no distinctive patterns in various groups. Where deterioration occurred, it was general rather than specific.

Babcock test.—Hall (1938) applied the 1930 Babcock test to 27 female drug addicts aged 22 to 57. Their scores were above their average for the total battery on tests of motor control and previous knowledge, but below that level on tests of memory, learning, and, especially, tests requiring close attention. Partington's (1940) 156 male addicts aged 18 to 68 displayed deficient learning and motor control but normal repetition. In epilepsy (Gottschalk, 1942) "there seems to be no impairment in formation of new associations, remote memory, orientation, mental clarity, recognition or meaning comprehension. Lack of retention for recent data, small memory span, slow comprehension of new ideas, less inability to concentrate and difficulty in special mental effort, are all characteristic . . . in this group." According to Brody (1942*c*) Babcock performance in dementia is quite good on rote repetitions and items of practical and familiar information; less good on memory tests, especially retention, and in motor control; worst on tests requiring new learning—the ability to profit from experience—and on items of information not directly

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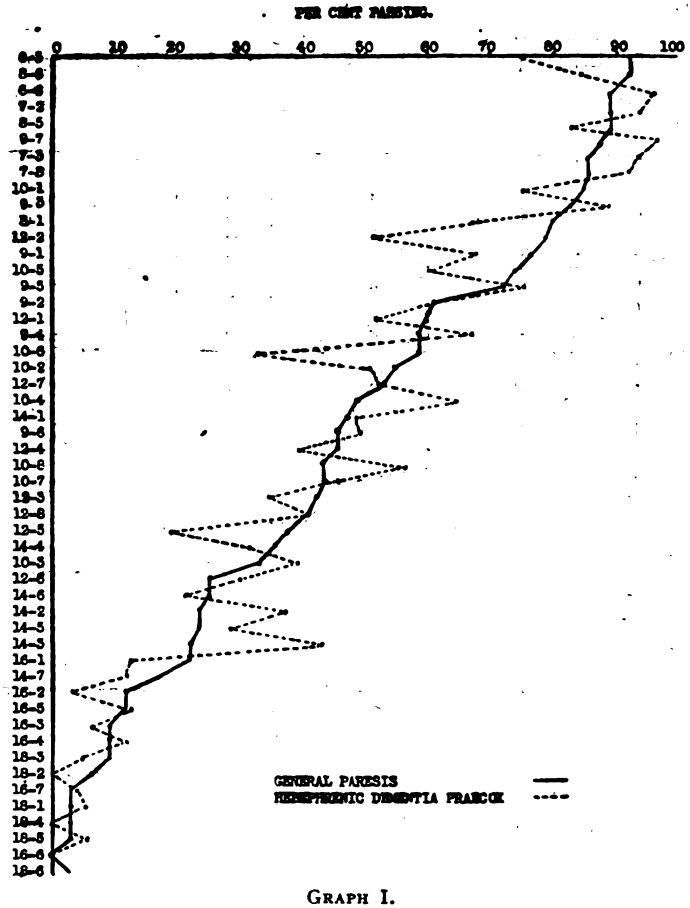
connected with practical life. But the same pattern is present in dementia of all degrees and in non-demented subjects of the same age (50–69).

Babcock (1941*a*) analyses pattern on the Babcock-Levy test in many syndromes. Although she much stresses the importance of analysing an individual's pattern of abilities, and although each diagnostic group has special features, "the likeness in the mental capacities of patients at equivalent degrees of impairment is striking. In all groups, ability to do something



GRAPH I.

which requires concentration and which cannot be done by dependence on old habits, scores the lowest. The next lowest is Warming Up. . . . Next are the first trials in learning tests but not the learning. After these are tests of fixation and recall. . . ."

Scholastic tests.—According to Jastak (1941), ". . . . high reading and low arithmetic scores tend to occur in mental states of a developmental nature and of long standing as in neuroses and schizophrenia, while high arithmetic and low reading abilities are more frequent in acquired psychoses due to alcoholism and syphilitic infection."

Discussion.—Although these researches have conflicting results, their

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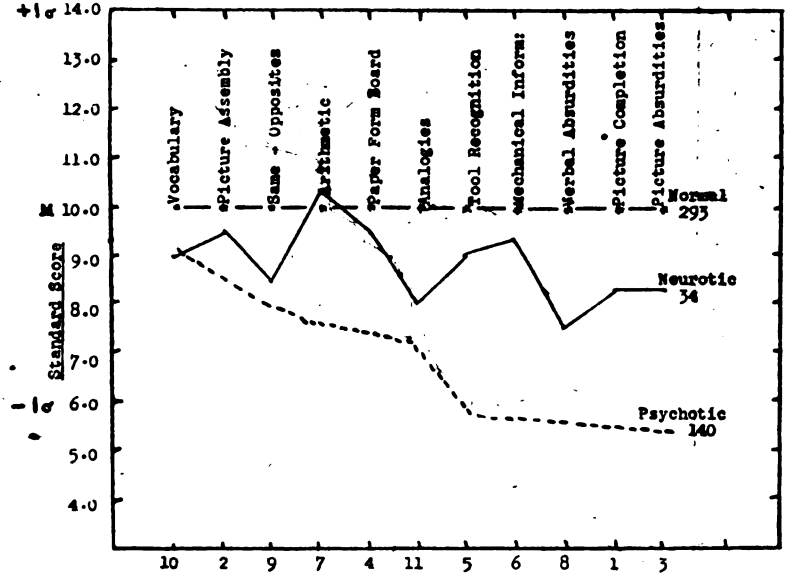
number and quality reflect the increasing importance attached to psychometric pattern. It is a pity that so much work has been done with "hotch-potch" scales, which make comparisons difficult. Wechsler's scale is to be recommended.

Perhaps the most frequent and striking conclusion is the similarity in organic and non-organic syndromes (Malamud and Palmer, Roe and Shakow, Babcock, Gilliland, etc.). On the whole Jastak's pattern—vocabulary highest, verbal scale next, non-verbal scale lowest—is confirmed, but with reservations. Vocabulary is now known to deteriorate earlier and more than was thought; and, in serious disorganization, there is a general levelling down of abilities. Further, more results comply with a principle of classification not according



GRAPH II.

to the material of the test, but on the extent to which the answer is ready made or has to be actively sought. Vocabulary, old school knowledge, and familiar information are of the first type. Non-verbal tests are usually of the second type. Mixed verbal scales, like the Stanford Binet, have items of both types.

Some, notably Babcock, regard patterns as reflections of native endowment, or of the effect of psychosis on true "intelligence." Such assumptions fail to consider two points. First, so-called psychotic pattern is displayed by normal persons at just the age when organic dementia is commonest (Magaret, 1942). Thus a dilemma arises. In early and slight dementia, the pattern is the same as in normal senility, and in more serious dementia, only a patternless low level is achieved. Even the classical memory defects of senile and arteriosclerotic dementia are thought by Shakow *et al.* (1941) to be due more to age than psychosis. Second, the demands made by tests as "pieces of life" are clearly in the reverse order

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to the ease with which answers can be given ready made. Thus, irrespective of any other factor, the faultier the "attitude," the greater the tendency to the pattern. Thus, as results show, the pattern appears less in young co-operative patients such as drug addicts and manic-depressives in remission than in schizophrenics, in whom it is less evident in paranoid than in hebephrenic types. In paraphrenia, better attitude is counterbalanced by usually greater age. It seems therefore that the above assumptions are not warranted. In young persons an uneven pattern may indicate abnormality—Bijou's suggested use of Jastak's pattern by service recruiting boards may be justified—or may help to confirm a suspicion of abnormality. But abnormality may be present in its absence. In persons over 50 it is probably without significance. A separate interpretation must be made for each individual. Despite much good work and more promise, knowledge of psychometric pattern is not yet enough for safe generalization.

VIII. Scatter and Irregularity.

Subjects only rarely pass every item on a composite scale at or below a certain level and fail every item thereafter. The dispersion between the level of complete success (basal age) and complete failure (upper limit) is termed "scatter." Scatter is also sometimes used to denote variability in different kinds of tests. "Irregularity" is a good term for this, since "variability," the obvious term, is also sometimes used as a synonym for scatter in composite scales.

Stanford Binet scatter.—Harris and Shakow, who demonstrated the high correlation of numerical measures of scatter with M.A., compared (1938) schizophrenic, delinquent and normal groups. The schizophrenics rated higher than the normals in Pressey and age-level scatter, but lower in Woodworth and Wallin scatter. On equating mental age, significant differences disappeared. They believe that scores of and above 8 in age-level scatter and 40 in Pressey scatter may be accepted as probable, but not invariable evidence of abnormality. Malamud and Palmer (1938), using four different measures of it, found scatter about equal in organic and schizophrenic groups, but considerably higher in both than in morons of the same mental age. Collins (1939) found increased and about equal scatter in G.P.I., schizophrenia and epilepsy. Kendig and Richmond (1940) found Pressey scatter low at the upper and lower, and high at the medium M.A. levels. On the average their schizophrenics were insignificantly more irregular than normals. But the greater range in schizophrenia suggested that exceptionally high scatter might indicate "functional disorder impairing the reliability of the examination, or organic involvement resulting in selective deterioration." The greatest range and highest median scatter occurred in the catatonic type; otherwise inter-group differences were slight.

Scatter in the revised Stanford Binet scale was studied by Brody (1942*c*) in demented and non-demented cases. He found that Harris and Shakow's critical limits do not apply in the revised version. Both Stanford Binet scatter and inter-test irregularity inadequately differentiated his subjects.

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Other tests.—Gilliland (1940) reported 35 per cent. more Wechsler scatter in 100 psychotic patients than in 100 controls. Magaret (1942) also found increased Bellevue scale scatter in schizophrenic and paretic subjects. According to Chase (1941), increased scatter characterizes hebephrenic performance of the Goodenough drawing a man test.

Discussion.—High scatter and uneven psychometric pattern obviously go together. The conclusions of the previous section therefore apply here. A further limitation on the usefulness of scatter is its relation to mental age. Where this is low, scatter is restricted by the poverty of the subject's powers; and where M.A. is high, scatter is restricted by the test "ceiling." Thus, comparisons are valid only between groups of about equal and about medium intelligence. Unfortunately, selection of such groups is beset with difficulty, for, as has been previously shown, to measure "intelligence" reliably in psychosis is almost impossible except in subjects who deviate so little from normal that their scatter is also likely to be normal, or in those sunk so low that their scatter is limited by their uniformly poor performance.

IX. The Diagnosis and Measurement of Intellectual Deterioration.

Re-test method.—One method of studying intellectual deterioration is to apply tests at intervals. This technique was first, and has so far been mainly, used in epilepsy. Barnes and Fetterman (1938) analyzed the Stanford Binet records of 35 epileptics over ten years. On the whole, deterioration was absent. This, too, was the conclusion of Rubisoff (1940), whose 66 epileptics dropped an average of only four Stanford Binet I.Q. points in from one to eleven years. Both luminal-treated and untreated epileptics sustain their performance according to Somerfeld-Ziskind and Ziskind (1940). Arieff and Yacorzynski (1942) reported an average drop in from one to ten years of only six Stanford Binet I.Q. points in 27 patients with "organic" epilepsy. Even this significantly exceeded the drop in 63 non-organic epileptics (Yacorzynski and Arieff, 1942). Thirty-seven per cent. of the first group and only 4·8 per cent. of the second consistently deteriorated. Collins (1941) however, after examining the Stanford Binet records over 12 years of 106 epileptics, reported deterioration in 65 cases, no change in 36, and improvement in only 5. All agree that the number and severity of the fits is not related to deterioration, which is, however, greater the greater the duration of the illness (Fetterman and Barnes, Collins, Harrower-Erickson).

Kendig and Richmond (1940) intensively studied Stanford Binet retests after several years in 72 schizophrenics. Thirty-one (43 per cent.) were too inaccessible to test, 31 (43 per cent.) advanced or maintained their level, only 10 (14 per cent.) deteriorated. Items wherein deterioration was most conspicuous were about equally of the eductive and non-eductive type. "Most of them however require close and frequently very sustained attention and the expenditure of considerable effort to solve them." They conclude that true intellectual deterioration is uncommon in schizophrenia.

Babcock and similar techniques.—The most popular current technique for

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measuring intellectual deterioration is, as in Babcock's test, to calculate the discrepancy between scores in vocabulary and in other tests. With Babcock's test, Hall (1938) and Partington (1940) and Barnes and Fetterman (1938) found only slight doubtful deterioration in drug addicts and non-institutional epileptics. According to Capps (1939) and Gottschalk (1942), Babcock indices usually correlate well with clinical estimates of epileptic dementia, but misleadingly tend to zero, because of vocabulary deterioration, in the worst patients. Capps found a moderate correlation between deterioration and hospitalization, but none between deterioration and age, education, original I.Q. and duration of illness.

Babcock (1941*a*), having matched subjects in vocabulary level, reports indices with her latest revision as normal, 0·0; normal Q. —1·0; psychoneurotic, —1·2; psychopathic personality, —1·9; simple praecox, —2·7; catatonic, —3·0; paranoid, —3·3; hebephrenic, —3·6; organic, —4·1. She also found (1940, 1941*b*) that normal subjects who scored at the extremes of Bernreuter intro- and extra-version and submission-dominance had interestingly large negative indices.

Vocabulary—Stanford Binet discrepancy.—The discrepancy between score in vocabulary and in the Stanford Binet scale deprived of vocabulary items and appropriately adjusted has been used like Babcock's scale. Malamud and Palmer (1938) found average discrepancies of 42·42 M.A. months in organic cases, 38.44 M.A. months in schizophrenics, and 0.84 M.A. months in morons of the same mental age. Davidson (1939) compared the discrepancies of manic-depressive and schizophrenic patients, mental defectives and normal children. Discrepancy was greatest in schizophrenia. Kendig and Richmond (1940) obtained results (Table VI) agreeing with their other evidence of the rarity of

TABLE VI.—*Vocabulary-Stanford-Binet Discrepancies* (*Kendig and Richmond*, 1940).

Diagnosis.	Number.	Discrepancy in M.A. years.
Nurses	217	+ 0·3
Employees	128	+ 0·1
Paranoid state	41	— 1·0
Total dementia praecox	477	— 0·2
Simple dementia praecox	14	+ 0·7
Hebephrenic dementia praecox	32	+ 0·1
Catatonic dementia praecox	51	— 0·1
Paranoid dementia praecox	41	— 0·9
With mental deficiency	22	+ 0·2

true dementia in schizophrenia. The comparatively high discrepancy in the paranoid patients probably arose from their relatively better preserved vocabulary.

Brody (1942*b*) calculated both the Babcock indices and the vocabulary-Stanford Binet discrepancy in three groups of patients with increasingly severe dementia. All the patients were fully co-operative and aged 50 to 69. He compared their performances with that of an equal non-demented group. He stressed the overlapping of groups at this age. "A critical level below which dementia is probable, if fixed low enough to exclude most non-demented patients, inevitably excludes some demented patients." He believed that the

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sensitivity of these measures could be increased by expressing discrepancies as percentages of the vocabulary score. He suggested the following interpretations:

Interpretation.	1930 Babcock.		1933 Babcock.		V-St. B. discrep.	
	Index.	Per cent.	Index.	Per cent.	M.A. years.	Per cent.
Absent or doubtful dementia	0 to −2·50	0 to 15	0 to −3·00	0 to 20	0 to 3	0 to 20
Mild or moderate dementia	−2·50 to −4·50	15 to 27	−3·00 to −5·00	20 to 35	3 to 5	20 to 30
Serious dementia	−4·50 +	27 +	−5·00 +	35 +	5 +	30 +

Shipley-Hartford test.—The Shipley-Hartford test (Shipley, 1940*a* and *b*) employs the same principle. The significance of the "C.Q." is "above 90—probably normal; 85–90, slightly suspicious; 80–85, moderately suspicious; 75–80, more than moderately suspicious; 70–75, very suspicious; below 70, probably pathological." Shipley and Burlingame's (1941) results are displayed in Table VII. Pollock (1942) discovered close correspondence between the scores and clinical condition of 50 patients, thus confirming the test's validity.

TABLE VII.—*Median Shipley-Hartford C.Qs.* (*Shipley and Burlingame*, 1941).

Diagnosis.	Number.	Median C.Q.
Normals	1,046	100
Private hospital patients	203	85
State hospital patients	171	65
Psychoneurotics	31	93
Manic-depressive depression	27	85
Manic-depressive mania	15	76
Schizophrenia	155	75·5
Involutional	17	75·5
C.N.S. syphilis	15	58

Other discrepancy tests.—Lidz *et al.* (1942) studied the vocabulary-Kohs' block discrepancy in definitely and doubtfully demented patients, schizophrenics and aphasics. In deciding that a discrepancy of over 2 M.A. years suggests deterioration, they failed to note the greater age of their demented patients. Brody (1942*b*), after investigating the discrepancy between scores on vocabulary and on Kohs', Passalong and Porteous tests, concludes that normal decline is so great in the second half of life that only a discrepancy of 50 per cent. of the vocabulary score constitutes indisputable evidence of dementia. Wesley (1942), without giving details, claims that 95 per cent. of organically demented patients can be differentiated by the discrepancy between vocabulary score and score on a varied battery of memory tests. Shaskan *et al.* (1942) found in 27 chronic encephalitics an average discrepancy of 30 I.Q. points between scores on the vocabulary, information and comprehension items and on the remaining items of Wechsler's scale. Hayman (1941, 1942) uses the simply and rapidly applied "serial sevens" test. Diagnosis is based on the number and pattern of errors or on a comparison with pre-morbid level as assessed by "the factors in the past history including school record and grade attained . . . or any standardized vocabulary test. . . ." In organic dementia, results correlated with clinical estimates. Failure of "conceptual attitude," especially in the presence of good vocabulary and verbal ability, helps to confirm

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the diagnosis of intellectual deterioration in doubtful cases (Nadel, 1938; Benton and Howell, 1941; Anderson, 1942, etc.), and is proportional to "deterioration" in schizophrenia (Adler, 1942).

Rationale of discrepancy tests.—Babcock believed that discrepancy occurs because the two parts of her scale test long acquired—therefore well maintained—and recently acquired—therefore easily lost, functions. Yacorzynski (1941) believes it arises because success in vocabulary can be achieved by a "number of separate and qualitatively different acts of unequal difficulty," whereas other problems can be solved only by specific methods.

Scatter.—Still another method of measuring dementia is by numerical measures of scatter. These are now little used, having been found unsatisfactory.

Premorbid level and dementia.—Brody's (1942*c*) groups of patients showed, as already stated, decline in vocabulary score with increasing dementia. This implies, he believes, not only an early clinically unsuspected vocabulary deterioration, but also that dementia occurs in inverse proportion to the premorbid intelligence. The latter belief is supported by results in normal senility (Brody, 1942*a*), epilepsy (Collins *et al.*, 1941), and senile and arteriosclerotic dementia (Shakow *et al.*, 1941).

Discussion.—Much confusion has resulted in the past from failure to distinguish true intellectual deterioration from dilapidation and disinterestedness. As has been shown, it is now recognized that the effect of both on mental test performance is very similar. Hence, intellectual deterioration cannot be diagnosed purely by mental test scores. The manner of obtaining the score must be considered. Where, however, this justifies the method, tests are useful for recording the progress of an individual, and for assessing relative severity in comparable cases.

Serial tests appear to be preferable for the first task, and discrepancy tests for the second. Each, however, has disadvantages. High test-to-test variability may impair the significance of serial tests. This is indeed the case, according to Harrower-Erickson, in epilepsy, in which the method has been most used. Discrepancy indices have two defects; they tend to zero in the most demented cases in whom vocabulary has severely deteriorated; and, after the middle years, they tend normally to be so high that their significance is hard to assess. Both the Babcock test and the Stanford Binet are also too long—and tedious—for routine use. Nevertheless, discreetly used, Babcock's test is of indisputable value. Further progress seems to be promised more by refinement and abbreviation of this scale than by search for new scales, or by brief paper-and-pencil scales, such as Shipley's, in which the manner of obtaining the score is not directly apparent.

X. Psychopathology Revealed in Mental Tests.

Both the quality of mental test performance and item-analysis provide interesting pointers to underlying psychopathology. Rorschach's inkblots and tests of conceptual thinking have been especially fruitful. It should be noted that evidence of impaired categorization has often been reported in tests other than those specially designed to reveal it—for example, in items of the Stanford Binet scale.

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Non-cognitive aspects of intelligence.—Not surprisingly, many comments reflect faulty reaction to the test as "pieces of life." Both Kendig and Richmond (1940) and Capps (1939), for example, refer to failure of effort and attention. Of rather different meaning is "loss of directional control of thought," described by Malamud and Palmer in schizophrenia and organic psychosis, and by Collins in epilepsy. This appears to refer to the non-cognitive, affective-conative aspects of "intelligence" itself. These are the aspects of intelligence which Brody believes are particularly affected in dementia. In normal senility, he says, cognitive deterioration may be as great as in dementia, but the affective-conative deterioration is proportionately much less. In dementia, all aspects of the psyche, and, in most cases, the physical condition too, are affected. Diethelm (1942), on analysing thinking in dementia as revealed by the application of special tests, stressed the importance of non-cognitive factors. Jastak (1939) also differentiates cognitive and other elements in intelligence. He distinguishes intellectual "altitude" and "relevance," and coins the words "encracy" to denote test evidence of disparity between them.

Psychotic thinking.—Cameron (1938*a* and *b*, 1939*a* and *b*), opposing a popular theory, denies that either senile or schizophrenic thought can be understood as a simple regression to a child-like mode of thinking. In schizophrenia, he distinguishes (1) asyndesis—"the appearance of loose clusters of terms in place of organically integrated concepts"; (2) metonymic distortion—"the use of terms or phrases that approximate the meaning striking somewhere on the periphery of the target instead of at the bull's eye"; and (3) interpenetration—"the concomitant appearance of co-ordinate themes interweaving with each other, and, through mutual interference, producing what at first glance looks like a mere jumble of words." These signs were not exhibited by senile dements who "apparently suffered from a dearth of (mental) material; and their organization, far from being too loose and too inclusive, was rather too simple and restricted." Capps supports Cameron's theories on the basis of tests applied to demented epileptics. Collins (1941), in contrast, found that the items failed by institutionalized epileptics suggested the influence of extrinsic factors such as social segregation and loss of normal environment rather than of epilepsy alone.

Korsakoff's psychosis.—Lidz (1942) asked patients to draw time after time a design somewhat resembling a face, but each drawing was removed after completion. The resultant distortions led to a theory that the fundamental disability is in constructing a continuum in time. This leads, first, to apathy about the present because there is no continuity of stimuli, next to confabulation with respect to gaps in the past, eventually to total disorientation. A peculiarity described by Zangwill (1941) in recognizing previously exhibited pictures, objects, and so on, may arise from this defect.

Efficiency in functioning.—Babcock (1940, 1941*a* and *b*) regards "efficiency of functioning," that is the tempo and control of perceptive, apprehensive and associative mechanisms, as the all-important factor in psychology. Where associations are too fast or too slow or without control, social difficulty ensues. The type of mental breakdown depends partly on the nature of the deficiency in functioning and partly on the individual's level of endowment in reasoning

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ability, memory span and so on. She believes that explanation of test failure by disturbance of mood or motivation is unscientific when all can be explained in terms of what she calls the "instinct of intelligence." Babcock traces the implications of her theory with ingenuity, but, it must be admitted, with some disregard of clinical evidence. This is a criticism that can be levelled against many theories in which interpretation of test results is attempted in purely cognitive terms.

XI. Mental Tests in Prognosis and Treatment.

The use of mental tests in assessing prognosis and the effects of treatment is an interesting recent development.

Shock therapy.—Here tests of the Goldstein type have been much used. For both spontaneous recovery and shock therapy the prognosis is good where conceptual attitude is preserved, and poor in its absence (Goldstein, 1939; Bolles *et al.*, 1938; Zubin and Thompson, 1941; Adler, 1942). Jastak (1939) reported that uneven psychometric pattern disappeared after successful insulin therapy. Wechsler *et al.* (1940) described a battery of five short tests, the results of which not only corresponded well with physician's estimates of the effects of treatment made soon after its completion, but when rechecked 6 to 18 months later, gave a more accurate "long-distance prognosis" than the clinical estimates. According to Graham (1940) patients who improve after insulin therapy display improved total score, diminished scatter, and a less typically schizophrenic Malamud-Palmer scatter pattern in the Stanford Binet scale, and give fewer individual responses in the Kent-Rosanoff association test. Initially good performance in absurdities augurs a favourable outcome. Statistically reliable improvement in test performance follows shock therapy (Wittman, 1939; Wittman and Russell, 1942). Correlation between improvement in mental tests, in tests of co-operation, and physician's estimates of the results of treatment was high between the first and second and between the second and third, but low between the first and third.

Effect of convulsive therapy on memory.—Tooth and Blackburn (1939) demonstrated impaired Babcock performance in patients treated with cardiazol in contrast to those who spontaneously recovered. Ziskind (1941) believes that after each treatment memory function is immediately greatly depressed, thereafter recovering in the next few hours. After a few treatments, however, recovery more and more falls short of the initial level, so that loss increases as the course continues. Wittman and Russell, on the other hand, failed to substantiate such findings.

Zubin (1941, 1942) and Zubin and Barrera (1941) studied learning of word associates before and after electro-shock therapy. Learning acquired immediately before treatment is affected more than learning which precedes shock by a longer interval. Memory traces are disorganized rather than destroyed. Levy *et al.* (1942) found, on testing "by the customary psychiatric methods," impaired memory in 2 of 11 metrazol-treated patients, and in 8 out of 13 patients treated with electro-shock. Impairment in the latter lasted from one to several weeks and in one patient was present after several months. Grinker, discussing this paper, compares these with punch-drunk patients in

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whom he asserted careful testing reveals permanent damage. Sherman *et al.* (1941), however, discovered no impairment in the memory of 10 patients treated with both metrazol and electro-shock.

Psychosurgery.—Hunt (1940, 1942) applied to patients before and after prefrontal leucotomy a variety of tests, many of which were specially designed to investigate the presence of signs commonly displayed by monkeys with lesions of the prefrontal areas. Very few significant defects followed the operation, and these, mainly revealed by the Rorschach test, indicated poor intellectual spontaneity rather than incapacity to reach pre-operative level. One or two patients tested by Mixter *et al.* (1941) showed similar changes, the others showed no significant change. Very little change was also discovered by Lidz (1939), Lyerly (1939), and Worchell and Lyerly (1941), although the last-named believe that the operation may decrease associative spontaneity (Stanford Binet, 60 words in three minutes). Division of the corpus callosum for the treatment of epilepsy also, according to Parsons (1940, 1942), appears to affect test performance surprisingly little. Kohs' block test is sometimes performed after operation as by subjects with "known cerebral lesions"; but the response is not uniform and often rises later to the previous level.

Anti-convulsant and sedative drugs.—Somerfeld-Ziskind and Ziskind (1940) compared changes in the records of 48 epileptics treated for one year with phenobarbital gr. 1½ twice or thrice daily with those of 42 untreated epileptics. The tests included the Stanford Binet scale, Goodenough drawing, a construction puzzle, Knox cube, a directions and an association test. Only slight changes were discovered and these were in the direction of normality. Collins (1941) and Yacorzynski and Arieff (1942), whose patients were treated over longer periods, confirmed this finding. The latter found that bromides also had no deteriorating effect, although the level in the blood reached 250 mgm. per 100 c.c. in some cases. Investigations of volunteers who took large doses of bromides for several weeks led to the same conclusion (Moore *et al.*, 1942; Jellinek and Bolles, 1942). It may be commented that the subjects were on the whole younger than those in whom clinical bromide intoxication usually occurs. Epanutin is also without effect on test performance (Ross and Jackson, 1940). According to Slater *et al.* (1942), small sedative doses of sodium amytal do not impair performance in the matrices test.*

Other investigations.—Women drug addicts tested by Hall (1938) insignificantly improved their average Babcock indices after treatment from −1·20 to −0·75. Epstein and Solomon (1939) applied the Stanford Binet scale before and after treatment of 78 paretics. They conclude that a final I.Q. of at least 70 is necessary to offer a chance of social survival; but that the extent of the pre-treatment fall and post-treatment rise as compared with presumed initial level is a better guide to prognosis than I.Q. itself.

Discussion.—Here, as always, it must be remembered that changed attitude may simulate changed power. The surprisingly slight effect of psychosurgery suggests perhaps that methods used with such interesting results by Conkey (1938), Nadel (1938) and Halstead (1940) in other types of frontal lobe disease

* Psychometric investigation of stimulants such as benzedrine have been mainly on normal children.

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should be widely adopted.* Otherwise the work summarized in this section needs little comment. Its practical value and its promise can hardly be exaggerated.

XII. Personality.

This chapter would be obviously incomplete without reference to character and personality tests. This section, however, will be short for several reasons. Although 68 tests are mentioned in Buros's 1940 *Mental Measurements Yearbook*, few have been applied in psychosis, and many that have been thus employed are as yet invalidated. Since the Rorschach test is a favourite tool in this work, many relevant investigations are considered elsewhere. Finally, although general studies have been attempted as by Arluck (1941) and Gottschalk (1942) in epilepsy, the object of these tests is usually to reveal individual peculiarities, so that results defy generalization. Only a survey of the most important techniques is therefore attempted here.

Observation.—The most direct method of studying personality is by direct observation, as, for example, of children's play. Every mental test session provides opportunities. Hanfmann (1941) and Brown and Rapaport (1941) find concept formation tests particularly valuable. The latter also study reaction to frustrated and impossible tasks. Cattell (1941) has designed a special test called the " Cursive Miniature Situations " test. In this a roll of paper is unwound past a window, providing the subject with varying situations to which he reacts, as well as he can, in accordance with previously given instructions.

Projective techniques.—Projective techniques are becoming increasingly popular. In these, the subject reveals himself by what he reads into meaningless data, or by his " organization " of amorphous material. Word association tests are the oldest of such procedures, Rorschach's the most used. The tautophone (Rosenzweig, 1942) is a device which presents for interpretation auditory stimuli in a manner analogous to inkblots in the visual field. In the " Thematic Apperception Test " (see Rosenzweig) the subject is asked for the interpretation, the origin and outcome of a number of scenes. In the Szondi test (Rapaport, 1941) the subject picks those he most likes and dislikes from six series of photographs of abnormal and criminal types. " Organization " of plastic materials, of Lowenfeld's coloured shapes, of strip cartoons, even of the dots made in a tapping test, have also been profitably analysed.

Questionnaires.—Questionnaires contain a large number of questions usually to be answered " Yes " or " No," so selected that the answers reveal dominant frames of mind. The best known of these, the Bernreuter Personality Schedule (Super, 1942) measures neurotic tendency, self-sufficiency, intro-extra-version, domination, need for and type of sociability. A new scale, the Minnesota Multiphasic Personality Schedule, contains no fewer than 550 questions and claims even wider powers. Rating and attitude scales are somewhat similar. In these, the subject may be rated by the examiner; or may rate himself in, for example, his level of aspiration; or may rate, for example, moral statements or facial beauty. As may be expected, few psychotic patients

* The work of Rylander and of Hebb and others who have collaborated with neuro-surgeons is pertinent here.

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are able to collaborate sufficiently with such scales. Indeed, Super cites only seven investigations of psychotic patients with the Bernreuter Schedule, and the results of these are conflicting.

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PSYCHOPATHOLOGY.

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PSYCHOPATHOLOGY is a speculative subject, whose limits remain undefined. It is concerned with the isolation of clinical entities on a psychological basis, and with the investigation of the aetiological factors and psychological mechanisms that may be responsible for these conditions. There is much division of opinion among psychopathologists on basic principles. Particularly is this so regarding the relative importance attached to innate factors, infantile experiences, early training and psychical trauma in adult life in the causation of mental disorder.

The chapter is divided into two sections. The first is concerned with additions to, modifications of and criticisms of the more important schools of thought on psychopathological theory. The second section deals with such psychopathological phenomena as are not specifically studied in other chapters. Where so much is subjective and all controversial, criticism has been reduced to a minimum.

I. THEORY.

Constitutional types.—Since Kraepelin, Kretschmer's work on constitutional types is possibly the most important single contribution to orthodox psychiatry. Of recent investigations in this direction Bowlby's monograph (1940) is one of the most significant.

Bowlby studied the pre-psychotic personality of 59 patients (13 schizophrenes, 23 affective-psychotics and 29 psychoneurotics). The questionnaire method was used, 105 character-traits and symptoms being listed. These were sub-grouped under the headings work and interests, social relations, attitude to authority, mood, temper, attitude to family, habits and obsessions, health. In most cases the patient's own answers were checked by information obtained from one or more relatives.

His findings confirm the view that most individuals can be recognized as belonging to one of two genetic types—cyclothymics and schizothymics. Since, as will be seen later, the cyclothymics are only isolated as a result of the absence of schizoid traits, it remains an open question as to whether there may not be other types—for instance, the epileptic. Bowlby disagrees with Bleuler's view that, except in extreme cases, all personalities are mixtures.

His second point is that, as has been contended by Mapother, Meyer, Lewis and others, the only difference between the normal, the psychoneurotic and the psychotic is a quantitative one. For instance, an obsessional may be schizoid or syntonic. The former may progress to schizophrenia, the latter have a

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melancholic episode. He finds it unscientific to isolate groups of cases into watertight compartments on the strength of a few outstanding symptoms; the personality should be taken as a whole.

Thirty-three traits are listed as being more or less specific for the schizoid personality, i.e. five traits or more indicate a schizoid, two or less a syntonic. The schizoid traits differ little from those of Kretschmer and need not be described here. The other 72 traits are non-specific and merely suggest an unstable personality; any of them may be present in the schizoid. Here Bowlby's findings are in opposition to those of Kretschmer, Bowlby's diagnosis of a syntonic being made on the absence of schizoid features, not on positive syntonic traits as postulated by Kretschmer. Bowlby also finds that Kretschmer draws rather too flattering a picture of his cycloids when he describes them as sociable and good natured, and attributes nervous characteristics to the intervention of schizoid components. He finds that an investigation into the previous personality of patients suffering from affective psychoses shows them to have been commonly referred to as quiet, keeping themselves to themselves, shy and so on.

There is one obvious criticism of Bowlby's otherwise important piece of research. It is difficult to see how in the absence of psychosis or specific physical features and merely on the absence of certain personality traits, one is to form a type out of what is only a residue, for this is all Bowlby's cycloids can claim to be. It is as if one insisted that modern painters, who did not use Seurat's pointillist technique, were all of one school, instead of being cubists, surrealists, primitives or followers of Cézanne.

Lastly one should note Bowlby's conception of the relation between the innate factor and environmental stress. Bowlby holds that "whilst heredity is responsible for the main type to which a given individual belongs, whether he is syntonic or schizoid, infantile and childhood experiences are fully as important as heredity in determining whether that individual develops a stable personality, or becomes unstable and so liable to develop one of those particular forms of mental illness which his inheritance has made available for him."

Bowlby has little if anything to say about the physical make-up of his patients. This interesting matter is the subject of a group of papers by Cohen (1938–41). An analysis of the measurements of male patients (25 manic-depressives and 22 schizophrenics) showed that, regardless of general magnitude of body-build, male manic-depressives tend to exceed male schizophrenics in waist and pelvic circumference, whereas the latter exceed the former in leg and arm length. Again, in a group of Jewish female patients (31 schizophrenes, 22 manic-depressives), it was found that there is a very marked tendency for the syntonic females to have deeper chests and broader pelves than the schizophrenes, this difference being independent of differences in general magnitude of body build. In a third paper Cohen applies the same measurements to 50 normal subjects of about the same age (male students at University College, London); unfortunately no attempt is made to correlate these results with the personality type.

Elliot (1941) compares 100 schizophrenic young women with 100 controls regarding body build. Only 10 per cent. of the schizophrenes were of the

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pyknic build, as against 40 per cent. in the non-psychotic group. Of the 50 per cent. asthenic and athletic types among the non-psychotics, 7 showed evidence of "instability." The author concludes that her findings support Kretschmer's theory. This is so to some extent, but here again it would have been of greater value if an attempt had been made to classify the non-psychotics according to personality type as well as body build.

The study of psychopathology in general, and the hypothesis of constitutional types in particular, stands or falls according to whether it is able to provide an aid to prognosis. It is therefore not out of place here to review those recent publications devoted to this subject.

Barham Carter (1942) studied prognostic factors in 78 cases of adolescent psychosis admitted to Shenley Hospital from 1935 to 1937. Relevant points from his conclusions are that, as regards physique, pyknosomatics had the best prognosis, dysplastics the worst. As concerns personality, he found that those showing an ability to come into contact with the world—some amiability, initiative and adaptability—were associated with recoverable psychosis. Those personalities lacking the above and showing a shut-in and sensitive reaction, unable to make social contacts and unable to stand up to reality, seemed unduly vulnerable to psychosis, and were likely to accept and retain psychotic reactions. Further he finds that intellectual and emotional poverty rarely recovered, and psychoses superimposed on mental deficiency were invariably malignant.

Kant (1941) made a study of 39 completely recovered and 39 deteriorated schizophrenic patients. In the recovered group he noted besides acute onset, psychogenic precipitation and the presence of clouding, extraversion (by which I think the author means the absence of a schizoid personality) and pyknic physique. Blair (1940) investigated a series of 120 male schizophrenics for prognostic factors. His findings as regards body-build and personality are in agreement with Kant.

Other workers have studied the constitutional make-up in the organic psychoses. In the case of dementia paralytica, Pollack (1939) has confirmed the findings of previous investigators, who show that the success of malarial treatment depends, among other factors, upon the previous make-up of the individual treated. Pollack found that the majority of the chronic paretics, who remained in hospital at least two years after adequate treatment, showed preponderance of schizophrenic reaction types.

Hoch and Davidoff (1939) made a similar study in relation to the traumatic psychoses. While admitting the importance of the severity of the trauma, the significance of the localization of the lesion and the role of other constellatory factors, they conclude that the previous personality is of considerable prognostic significance. They found that cases with a schizoid or introvert make-up regained their mnestic functions and the lucidity of their pre-psychotic intellectual state, but unharmoniously retained their hallucinations and delusions. The ratio of unimprovement in the introvert type as compared to the extravert type was approximately 2 to 1. It should be noted that Hoch regards the terms extravert-introvert and cycloid-schizoid as practically synonymous.

In another publication (1940) Hoch made a study of 200 cases of alcoholic psychoses. He found that 72·5 per cent. were predominantly extravert—a

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ratio of 3 to 1. Of the extraverts 78·3 per cent. recovered, while of the introverts only 26·3 per cent. recovered. As regards clinical types, he found that there was a very marked preponderance of extraverts in those whose psychosis took the form of delirium tremens or confusional states. Introverts were in excess among those with acute hallucinosis and paranoid states.

Psychoanalysis.—The roots of psychoanalysis, that is the hypothesis of the unconscious and the mechanisms underlying unconscious motivation, had been firmly established in the early years of this century.

When looking to recent developments I find no offshoot of major importance during the period covered by this survey. On the other hand, there are three main branches, which have had their origin within the last ten to fifteen years. Recent work has largely been confined to an extension, refutation or limitation of these concepts. There has been also much research into technique, a subject outside the province of this chapter.

Of the three main branches, the first is the increasing interest that has been taken in ego-psychology. Freud first broached this subject in *The Ego and the Id* (1927); ego defence-mechanisms were first studied in some detail in his *Inhibitions, Symptoms and Anxiety* (1936).

In a paper by Bibring (1941), recently translated, there is an excellent summary of the development of Freud's theory of instincts. Bibring isolates four stages in this development, and stresses that though the theory has undergone many changes, it has remained consistently a dualistic conception. In the first stage the sex instincts were isolated from the ego instincts. The former were closely studied, while the latter remained an unknown quantity. In the next stage the concept of narcissism was introduced. This led to the postulation of a libidinal component of the ego instincts. Freud, however, insisted that there must also exist a primary non-libidinal component; this he called "interest" in a non-commital way. The third stage was that the aggressive trends were ascribed to the ego instincts as being among their essential constituents. The last and most recent stage was due to a growing knowledge of the structure of the mental apparatus as a whole, and its division into a "vital" stratum (the id) and an organized part (the ego), and to a study of the unconscious region of the ego, the super-ego. The gist of this view was that the aggressive trends were no longer regarded as primary attributes of the ego instincts, but as independently existent instincts of aggression and destruction existing side by side with the sexual instincts in the vital stratum of the mind. The ego instincts ceased to be independent entities, and were derived partly from the libidinal and partly from the aggressive instincts. This latest development also postulated the existence of primal instincts—the instincts of life and death.

In 1937 Anna Freud made an important contribution to ego-psychology. In this work the technique of psychoanalysis is used in order to investigate the ego itself. Previously the method had been used to explore the unconscious mind, any information discovered about the ego being in the nature of a by-product. Anna Freud finds that the ego is fundamentally hostile to the instincts, and her investigations are mainly concerned with the mechanisms used by the ego to ward off anxiety aroused by the intrusion of the

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instincts. These mechanisms include regression, repression, reaction-formation, isolation, undoing, projection, introjection, turning against the self, reversal and sublimation. Again she finds that there are three main motives for this defence against the instincts. The most familiar is super-ego anxiety, as it occurs in adult neurosis when an instinct is gratified or even merely aroused. This has led to the belief that the super-ego is the root of all neurotic illness. According to certain theorists, if the super-ego were weakened by bringing up children leniently, that is by allowing a maximum instinctive gratification, there would be no neurosis. Anna Freud, with the majority of psychoanalysts, is sceptical both of the theory and its implication.

The second motive is objective anxiety as it occurs in infantile neurosis before the super-ego has come into being. The examples of the ego defence mechanisms here studied are: Denial in phantasy, denial in word and act, and identification with the aggressor.

The third motive is instinctual anxiety, that is, dread of the strength of the instincts. Especially at puberty and at the climacteric owing to physiological changes, there is a sudden accession of instinctual energy, which threatens to upset the balance of the psychic institutions. The last section of the book gives a masterly study of this form of anxiety and the ego defence mechanisms as they occur at puberty. Her analysis shows that two striking characteristics of the adolescent, asceticism and intellectuality, are actually defence mechanisms by means of which he attempts to come to terms with the instincts.

Fenichel (1938) notes that in recent years the ego has taken the place originally occupied by the instincts as the chief object of psychoanalytical investigation, and sounds a note of caution. While condemning those psychoanalysts who believe that only the deepest, genetically earliest layers are of importance, and who are not interested in comprehending the surface as the differentiated product of the instincts, he also condemns the supporters of the other extreme who forget the id while concentrating on the differentiation of the ego, and take from psychoanalysis its biological basis—that of instinctual needs.

In support of the above he reminds us that it is important that the words "ego" and "id" should not be taken too rigidly. Whatever the mental mechanism may be that is under investigation, id and ego elements will form component parts. Even an instinctual fixation is not only due to a particular satisfaction or frustration of the instinct in question, but at the same time serves as a defence or reassurance.

Fenichel's main contention is that the id can only be attacked *via* the ego, it being the object of the analyst to divide the ego against itself by separating the reasonable observing ego from the automatic, defensive, experiencing element. In his view there was to begin with a conflict urgent and alive. The subject withdrew from this conflict by means of permanent ego-alterations. A latent state had been reached, for the forces which at one time opposed each other are now wasted in the useless and hardened attitudes of the ego. It is the object of analysis to reactivate the old conflict and to set free the bound energy.

Helene Deutsch (1939) carries on the study of ego defence mechanisms in an

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investigation of "intellectual resistances." She finds that certain patients attempt to retain the *statu quo* between the id and ego by means of certain intellectual forms of defence. She isolates three types:

(*a*) Highly intellectual individuals with genuine sublimation.

(*b*) Obsessional neurotics, whose intellectual resistances usually take the form of direct "reaction-formations" or "isolations."

(*c*) Patients with blocked or disturbed affects, who, having repressed the affective side of their life, have retained the intellectual side as the sole means of expressing their mental personality.

She does not agree with Anna Freud's view that the tendency to intellectualization in puberty is an effort of the ego to master the instincts with the aid of thought processes. In her view, this form of defence appears only in those young people in whom specific instinctual tendencies in early childhood have already prepared a defensive process of this kind, and in such a manner that that process can cover a gratification of instinct. For instance, in the case studied, it was sexual curiosity and everything connected with it which was indirectly gratified by the "intellectualization."

Reik (1941) agrees with Anna Freud that identification with an aggressor is a special instance of identification for the purpose of mastering anxiety. He adds, however, that between the stages of anxiety and aggression there is hatred of the aggressor. He does not think that Anna Freud is right in thinking this is an intermediate stage in the development of the super-ego. Reik thinks, on the contrary, that it is because the super-ego is exceptionally severe that the ego must project the aggression if it is to remain intact. The development of the super-ego is not too feeble, but too powerful in relation to the ego and to the subject's self-feeling. Finally he maintains that aggression based on identification with an aggressor is originally a response evoked, not by an anxiety-situation, but by a danger situation. Only later does it come to be employed secondarily as a defence against anxiety. As Reik explains, anxiety may be regarded as a buffer or safeguard adopted by the ego to ward off fright —the reaction to an objective danger-situation.

The second important contribution is associated with the name of Melanie Klein. In 1933 she published her *Psychoanalysis of Children*, where an important discovery in technique—play analysis—is introduced for the first time. As a result of her research she concluded that identification and consequent super-ego formation take place at a much earlier age than formerly had been realized. In a later work (1935) she follows Freud and Abraham in stressing the importance of introjection in the psychogenesis of melancholia, but goes much further. For Klein and her followers introjection has become the all-important mechanism in the child's development; other processes have faded into insignificance. This theory has been severely criticised by many, and has produced something of a cleavage within psychoanalytic circles.

Fairbairn (1941), strongly influenced by the Klein school, attempts an ambitious revision of psychoanalytic theory. He finds Abraham's conception of fundamental erotogenic zones an unsatisfactory basis for any theory of libidinal development, because it is based upon a failure to recognize that libidinal pleasure is fundamentally just a signpost to the object. Fairbairn

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does not dispute that schizoids are fixated at the early oral and depressives at the late oral stage. His main criticism is levelled at the two anal and the phallic phases, which he considers to be artefacts. In his opinion, paranoid, obsessional, phobic and hysterical states essentially represent, not the products of fixation at specific libidinal phases, but simply a variety of techniques employed to defend the ego against the effects of conflict of an oral origin.

Fairbairn's own theory is based directly on the relationship of the ego to the object, and it must be remembered that, for this school, the breast is the original object for which every subsequent object is an indifferent substitute. He traces the development of object-relationship from the infantile dependent stage, characterized by an attitude of taking and based upon identification, through a transition stage of quasi-independence to a stage of mature dependence, characterized by an attitude of giving and based on differentiation of the object.

The schizoid and depressive fail to establish a satisfactory object relationship during the infantile period. In the schizoid the emotional conflict arises in the early oral phase, taking the form of the alternative " to incorporate or not to incorporate," i.e. " to love or not to love." The schizoid is pre-ambivalent; hate does not enter into his relationship with the object. But every relationship with a loved object is seen as one of oral incorporation and, therefore, to love is to eat and destroy the object. In consequence he is afraid to love and erects barriers between himself and objects. As libido is withdrawn from objects it is directed towards internalized objects; hence the introversion and narcissism of the schizoid. In the depressive the conflict arises in the late oral phase, and the problem is how to love the object without destroying it by hate; he is capable of ambivalence and aggression. It is when his hate is directed towards the internalized object that a depressive reaction supervenes.

Paranoid, obsessional, phobic and hysterical reactions are fixated at the transition phase. Here there is no longer ambivalence but dichotomy of the object—the original loved and hated object is replaced by two, one of which is accepted and the other rejected. Paranoid and obsessional states employ special defensive techniques which derive their pattern from rejective excretory processes. The paranoid externalizes the rejected object and treats it as a persecutor. For the obsessional the excretory act represents not only rejection of the object, but parting with contents. The conflict of the transition period also represents itself as a conflict between an urge to expel and an urge to retain contents. Both attitudes are attended by obsessional anxiety —the attitude of expulsion being attended by a fear of being emptied or drained, and the attitude of retention by a fear of bursting. The phobic and obsessional techniques represent two different methods of dealing with the same basic conflict. From the phobic point of view the conflict presents itself as one between flight from and return to the object. From the obsessional point of view the conflict presents itself as one between expulsion and retention of the object. Concerning hysteria, Fairbairn thinks it is superfluous to bring in an Oedipus situation to explain the rejection of the sexual organs, since it is clear to him that " the hysteric identifies the genital organs as a part-object with the original object of the libidinal impulse at the stage of infantile depen-

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dence, viz. the breast." This rejection, therefore, is an unsuccessful attempt to abandon the attitude of infantile dependence. The distinctive feature of the hysteric is that the rejected object remains incorporated.

I. M. Blanco (1941) strongly criticizes the Klein school for their universal application of the mechanism of introjection. He finds developments here "reminiscent of the casuistry of the Middle Ages. The introjected object has become something so concrete, so well delimited or sharply defined, that when one hears of people introjecting either the whole or part object, and then projecting it on to the outside world, introjecting it again, cutting it to pieces, blowing it up, putting the pieces together again—when one hears all this one cannot help recalling the animistic conceptions of children and primitive people." He believes that the term is of real value in explaining the processes at work in melancholia, but that it is a mistake in procedure to apply the conclusions drawn from those suffering from severe depression to all human beings. He admits that the phantasy may be there, either in the mind of the analysand or of the analyst, but this does not mean that the interpretation is correct. He speaks of a juggling with words and a distortion of clinical material to fit preconceived theory. For instance, the absorption of milk has many symbolic meanings for the normal mind, but for Klein and her followers these symbols would invariably be explained as an introjection of a part object—the maternal breast.

The third main sphere of development has been the application of psychoanalytical theories to psychosomatic medicine, a subject discussed in the second section.

During recent years there have been at least two attempts to subject the basic hypothesis of the psychoanalytic theory to a critical examination. Of these Dalbiez's work (1941) is the most ambitious, and deserves a very careful examination.

Dalbiez is a trained and practising psychoanalyst. He is also a philosopher, and it is as philosopher that he approaches the fundamental tenets of psychoanalysis. One of Dalbiez's main criticisms is that Freud makes no clear distinction between methodology and doctrine. It is with certain features of the latter that Dalbiez is in total disagreement. The first volume is devoted to an exposition of the Freudian theory and need not detain us here. The second volume provides the critical discussion. The subjects discussed are the unconscious, psychodynamics, methodology, sexuality and sublimation.

Regarding the unconscious, Dalbiez has little use for either the idealistic or the materialistic approach. He approaches the problem as a realist, taking as an axiom that "external sensation is an organic-psychic operation, unconscious *per se*, which directly apprehends an actual material reality." From here he has little difficulty in building up the argument that consciousness does not coincide with psychic activity. This view is reinforced by an examination of such phenomena as habit, artistic and scientific inspiration, hallucinations, obsessions and various disorders of personality. He then turns to Freud's theory of psychic dynamisms, which he believes can be verified by the application of Pavlov's physiological experiments on conditioned reflexes and artificial neuroses.

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Turning to methodology, Dalbiez makes out a very strong case for the scientific validity of the associative and symbolic method of exploring the unconscious, if properly applied. Regarding free associations Dalbiez cites five criteria by means of which the accuracy of an interpretation can be judged. These are spontaneous evocation of memories, similarity between the associative fact and the conscious element, frequency of the same association, convergence of the first criterion, and the objective verification of the accuracy of the memory. Discussing symbolism, Dalbiez thinks that much of the opposition is due to the confusion created by the use of the word " symbol " in the sense of index or effect-sign. He suggests that if Freud had represented the dream as a psychic symptom of deep psychic states, he would have been better understood and much less criticized. He further demonstrates that Freudian symbolism or effect sign can be indirectly confirmed by the study of language, myth and folk-lore.

Dalbiez is much less sympathetic towards the Freudian sexual docrine. He agrees that infantile sexuality is normal, and that there is a genetic link between infantile sexuality and the sexopathies. On the other hand, he criticizes the view that the normal infant is a polymorphous pervert. In his opinion the infant's sexuality is merely undifferentiated and unintegrated, and he would substitute the term " polymorphously pervertible." He is also very sceptical of the universal applicability of the " sexual " Oedipus complex, the theory of erotogenic zones and the developmental stages of sexuality, and finally the theory of the death instinct.

Dalbiez next turns to morbid psychic causality. Following Hughlings Jackson he contrasts negative symptoms proceeding directly from the lesion with positive symptoms, the reaction of the healthy organs. A long philosophical argument leads him to the conclusion that the most that can be said in favour of psychic causality is that in certain disorders there is the predominance—not the exclusiveness—of the psychic factor in the aetiology.

Dalbiez is quite unable to support the Freudian doctrine of the pan-sexual aetiology of the neuroses. He finds that its role is very limited and often unnecessary as far as the negative symptoms are concerned, and no one has as yet succeeded in demonstrating that all positive symptoms are related to the sexual instinct. Dalbiez is particularly severe on the psychoanalytical doctrine as it is applied to the higher spiritual values. His argument against determinism is, in the main, that it cannot be proved. Nevertheless for scientific work it is a useful hypothesis, which is more than can be said for free will, as Bertrand Russell has made abundantly clear. To disprove Freud's theory that morality is derived from the Oedipus complex, he quotes Malinowski's scathing criticism of the cyclopean hypothesis. Against Malinowski's unsubstantiated statement that Freud's primal horde never did and never could have existed, there are the very careful observations on the social behaviour of sub-human primates by Zuckerman. Dalbiez makes no reference to Zuckerman's work. Lastly, on the Freudian interpretation of religion and art, Dalbiez would appear to have misunderstood Freud. It is constantly reiterated that psychoanalysis can tell us nothing as to the essence of religion or art. If by essence is meant the platonic forms, there is little doubt that Freud would have been the first

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to agree. All psychoanalysis attempts to show is that in a given individual the particular religious or artistic content is determined by the way he reacted to infantile sexual problems.

The second critical examination is a contribution by Herold (1941). While agreeing with the super-structure, Herold subjects some of the basic psychoanalytic concepts to severe criticisms. His views evolve from Descartes, Kant and Schopenhauer and show an extreme dualism. Regarding the undifferentiated self he discards Descartes' knowing self and Schopenhauer's willing self in favour of Freud's pleasure-pain self. In some way and for some reason not explained he finds that only in the pleasure-unpleasure experience is there no objective interference. The ego stands midway between this subjective world of pain and pleasure and the objective world of things, partaking of each.

Herold thinks that Freud's sexual theory would have been more acceptable if he had used the term "sensuality." He shows very clearly that the process of "loving" an object is essentially a process of knowing it, and that in the infant this loving and knowing objects is not so much a symbol of the sexual act as a forerunner of it.

On the libido theory of energy or drive Herold believes that the motive power is supplied by the body substance, or that part of the ego-concept which is non-self. The self, however, though unenergized, is credited with the power of directing this energy or drive towards a given end. He goes on to explain that there can be changes of direction and of intensity of drive, but not changes of quality. Therefore there is no place for such concepts as sexual, destructive, or other specific instincts. The term "instinct" is, in fact, unnecessary except to express those few inherited mechanisms through which our drives find an outlet. It is essential for healthy behaviour that energy should be free to flow out on to objects. Fixation of energy on the body substance is correlated with Freud's destructive instinct. Death, therefore, is the result of accumulated energy centred upon the body substance. A moderate degree of such fixation but a degree beyond normal limits is called narcissism.

Analytical psychology.—Much of Jung's work has been devoted to schizophrenia, and it is, therefore, not surprising that many of the recent contributions from analytical psychologists have been concerned with this psychosis.

In a recent paper (1939) Jung sums up his views on the aetiology of schizophrenia. He agrees with his teacher, Bleuler, that psychological causes produce the secondary symptoms. On the other hand, he considers that an organic cause for the primary symptoms has yet to be established. He points out that the biology, anatomy and physiology of this psychosis have been fully studied, while its psychology remains a vast and unexplored field. Until the psychological side has been more fully investigated there are advantages in treating schizophrenics as if they were psychogenetically determined and could be cured by psychological means.

In Jung's opinion there are two aetiological groups of schizophrenics. In one group the primary symptoms coincide with the condition which Pierre Janet has formulated as "*abaissement du niveau mental*," that is, it is due to a peculiar "*faiblesse de la volonté.*" In the other group it may be a question of atavism, or "*developpement arrêté.*" Here a more than normal quantity

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of primitive psychology remains intact and does not become adapted to modern conditions.

Both schizophrenia and neurosis are consequences of "*abaissement*" and in both the result is dissociation. The difference, for Jung, is quantitative as far as the dissociation is concerned, but leading to qualitative differences in the personality as a whole. A neurosis is a relative dissociation, a conflict between the ego and a resistant force based upon unconscious contents. The characteristic of the neurotic is that he fights for and maintains the supremacy of his ego-consciousness and subjugates the resistant unconscious forces. On the other hand, in schizophrenia there is dissociation of a different and much more serious nature. "The psychical totality falls asunder and splits up into complexes, and the ego complex ceases to play the important role among these. It is just one among several or many complexes which are equally important, or perhaps even more important, than the ego is." Though Jung sees a clear dividing line between neurosis and psychosis, he also finds that many cases of neurosis may prove to be latent schizophrenics. For many years they may maintain ego-supremacy and then, as a result of some unusual stress, there may be generalized disruption of the personality.

Baynes (1940), in a recent monograph, makes an important contribution to the psychopathology of schizophrenia. The work is devoted to an analysis of the artistic productions of two "border-line" schizoid subjects. The two series of paintings and drawings are of exceptional psychological interest, and the productions of the second subject are not without artistic merit. The analyses show that the genesis of the disease embraces two relatively independent factors—namely, the weakening of the conscious threshold on the one hand, and the activation of the unconscious on the other. It is admitted that other factors, heredity and emotional trauma in childhood, are also of significance, and in both the subjects studied, immediate conflicts were precipitating causes.

As is well known, according to Jung, there is, beyond the personal unconscious, an archaic or collective unconscious common to all. These archaic contents are experienced consciously as universal myths. They, the archaic contents, are not specific to schizophrenia; only the attitude which permits them to rule in place of the authentic personality is truly psychotic. Baynes agrees with Jung that two groups of schizophrenia can be recognized. In the one consciousness is weak and, therefore, unable to keep back the flow of unconscious material. In the other, normal consciousness is suddenly confronted with a strongly activated unconscious which it cannot withstand.

During the acute state of conflict the schizoid subject is in an introverted state, his consciousness being dominated to a varying extent by unconscious material. The psychotic is at this stage trying to solve his conflict by means of a myth or fantasy expressed in symbolical language, and in these specific cases by bizarre paintings and drawings. Baynes is of the opinion that the religious question underlies the majority of psychopathological disorders; it is this question that the myth attempts to solve. As analysis proceeds, the evolution of the myth is reflected in the artistic products. At first these are purely concerned with symptoms or unresolved complexes; later and to an

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increasing degree there is evidence that libido is being directed outwards, of a creative urge and of a desire to adapt to society.

It is also hinted that, besides providing a solution for personal problems, the content from the archaic unconscious may also have a prophetic value not only for the individual but for humanity at large.

Drawings play an important part in the therapeutic work of the analytical psychologist. G. Adler (1941) studies the dream of a border-line schizophrenic aged 30, of the intuitive intellectual type. There are three parts to the dream symbolizing, according to the author, the persona, the personal unconscious and the collective unconscious. On the author's request the subject continued his associations to the last part of the dream in a series of drawings. Analysis showed that the dream expresses the patient's fear of facing the problems of his emotions and of his instinctual life. The task of the analysis is to integrate within the patient's consciousness the disruptive tendencies which spring from primitive and still unconscious levels of feeling.

Analytical psychologists, like psychoanalysts, insist on the importance of infantile trauma in the aetiology of the neuroses. Baynes (1937) believes that the main difference between the Freudian and Jungian approach is that the former is a study of psychic mechanisms, the latter an understanding of values. For Baynes the Oedipus complex is merely a symbolical expression of the drama of the unconscious, evolution *versus* regression. "The vital energy either flows forward to its evolutionary objective or backwards to its source. In the human family the backward stream of libido is necessarily motherwards, seeking, apparently, the original state of contained security. The father represents the cultural symbol of masculine authority and progression." Baynes finds that severe injury to the child's psyche does not so much result from brutal acts and shocking experiences as from living in an atmosphere of insincerity. Nothing, he believes, is more likely to provoke neurosis than to be brought up by parents who teach one code of morality, while practising another. The child, he maintains, is "the potential indicator of his parents' unconscious problems."

Individual psychology.—Individual psychology has been well defined by Wexberg as "a means of understanding or an attempt to understand an individual through a study and interpretation of the goals he has set himself to achieve." In a recent paper Squires (1938) enlarges on this definition. He regards four concepts or conceptual terms as of primary importance for an understanding of the Adlerian approach. The first of these is purpose. It is postulated that the organism, consciously or unconsciously, has an urge to attain some higher state or end. The second is what Squires calls creative power, "the ability an organism—in this case a human organism—is presumed to possess that enables it to mould within definitely prescribed limits its future destiny and fate." It is, of course, this latter postulate that brings Adlerian theory into line with the other dynamic psychologies. The third concept is a quantitative one, and Adler calls it "activity or degree of activity." According to Adlerians the abnormals can be distinguished by the degree of activity, neurotics being the least active, delinquents the most active, and perverts taking an intermediate position. Squires assures his readers that he

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has found this last concept very helpful; the more pertinent question would seem to be: Is it true? The last of these concepts is social or community interest. Adlerians stress that though the individual is a purposive unit, he is not in isolation but a member of a group. The key to successful therapy is to guide and establish personal interests within group interest. Shyne (1941) also thinks that the main value of individual psychology is the stress laid on social factors, so paving the way to a *rapprochement* of sociology and psychiatry. Normality, it is explained, implies an equilibrium between individualism and social feeling, while neurosis implies a lack of sufficient social feeling to maintain this equilibrium.

Adler was certainly one of the pioneers in the field of psychosomatic medicine with his well-known concept of organ inferiority. His theory is, however, the obverse of that of other psychologists (see section on psychosomatics). According to Adler organ inferiority is a cause not only of disease in that organ, but also of psychological maladaptation; while in the opinion of other schools it is psychological difficulties that may set in motion organic dysfunction. There would seem to be little doubt that the Adlerian view is correct for certain specific cases, but the generalization is by no means proved. As Shyne rather naïvely admits, it is sometimes very hard to determine the presence of organ inferiority on account of hyperfunction of the defective organ, through increased action of another organ, or because of compensatory activity of the central nervous system. In his later writings Adler posited a number of other causes for inferiority reactions, such as environmental stresses, parental attitudes, sex and position in the family constellation. As far as the present writer is aware *Individual Psychology Pamphlet* No. 9 (1933) is the most recent study of specific psychosomatic disorders.

Like the psychobiologists, the individual psychologists make the point that the individual is a somatic whole. They differ, however, from other schools in that they find that this whole is united in purpose and aim; for the Adlerian, psychological conflict does not occur. To quote Crookshank (1937): "Here we have a terrific line of demarcation between I.P. and the psychologies which deal with persons as agglomerations of separate qualities and things, which make them the sport of material and efficient causes: the sport of inherited tendencies, of congenital variations, of biological predestination." He then goes on to explain that every idiosyncrasy of behaviour is an expression of the individual personality and of his purpose in life. Even doubt is not an expression of conflict; he chooses "this state of doubt so as to fulfil his own purpose." The fallacy of the above argument is that whatever else it does it brings forward no evidence to refute the theory of conflict; still less does it show that there is unity of purpose. Pavlov's experiments in artificial neurosis in animals would seem the strongest argument favouring the hypothesis of intrapsychic conflict as a useful concept. Concerning doubt and aim it may be true that the mule has chosen to remain between the haystacks, but would he regard this as even a fictive goal?

In a short paper Woodcock (1938) summarizes the Adlerian attitude to sexuality. We learn that for everyone the true goal is monogamy, official or unofficial. Every other exhibition of sexuality represents a failure to achieve

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this aim and is explained as a manifestation of the will to power. For example, autism is a refusal to give; impotence is due to fear of a dominant partner; ejaculatio praecox is due to egotism; frigidity and vaginismus are reactions to the female's feeling of inferiority; "homosexuals are cowards who fear to function on normal healthy lines, but many attempt by craftiness to elevate their weaknesses into a 'fictive' superiority." Sadism is a demonstration of superiority, and masochism is sometimes used by the oppressed to turn the tables on the oppressor or sometimes is a manifestation of guilt. It will probably be agreed that while these factors may be present, they only represent a small part of the psychopathology in a portion of the cases.

Psychobiology.—Noyes (1942) provides one of the most recent attempts to formulate the theory of psychobiology. He classifies it as "that branch of biology that deals with the organism as a person—a biology of the personality, a study of its natural history." This psychobiological entity, which is known as the human personality, is defined as "an integration of all functions of the human organism including that of the mind, the function of which is characterized by symbolization." The personality must be examined both from a genetic and dynamic viewpoint. Personality is the product of the total forces of the organism. To understand its mechanism one must have data from the chemist, physicist, biologist, physiologist, anthropologist, sociologist and psychologist. Noyes postulates an evolution of this psychobiological unit—the personality. Its dynamics and force of development depend upon an interaction between the innate biological drives and affective needs of the individual and the social and cultural environment. Not only does the individual meet with frustrations from the culturally-conditioned environment, but there are also internal incompatibilities in its own values. Primary urges common to all are often at variance with drives, needs and tendencies peculiar to the individual. The psychiatrist should approach the personality with the assumption that all its expressions are those of fundamental, underlying psychobiological dynamics, and should regard mental disease as an undesirable, socially impracticable functioning of the personality. Symptoms are regarded as rational but extreme psychobiological reactions—"the exaggeration of processes that have long been operative in the individual processes, however, which because they do not adequately meet the needs for which they were created, became so intensified and striking as to be called symptoms and, if disregardful of reality, psychotic symptoms." The psychiatrist should attempt to analyse and reconstruct in their flow of dynamic relationship the common factors operating both in the prepsychotic personality and in the psychosis. In both there will be revealed the way the patient has reacted to specific personal needs.

Noyes believes that this formulation tends to exclude a point of view permeated, on the one hand, with dualism or, on the other, with quasi-animistic concepts, both of which unduly suggest the antithesis between mind and body. It tends also to prevent an overstressing of the theory that the normal basic personality is largely biochemically determined, and that therefore mental illness with its exaggerations of personality is likewise determined. It is further consistent with the belief that the person with nervous or mental

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symptoms is of fundamentally the same organization as the so-called normal.

If the above is compared with the Adlerian conception it becomes clear that the two schools have a very different conception regarding the structure of the psychosomatic unit.

Henderson and Gillespie's *Text-book of Psychiatry* is, of course, very much indebted to the school of psychobiology. In the latest edition (1940) Meyer's most recent classification of mental illness is discussed. This classification epitomizes the Meyerian psychopathological theory. Meyer does not speak of mental diseases but of reaction-types. This term makes it clear that, in Meyer's opinion, the constitutional factor determines how the psychobiological organism will adapt or fail to adapt to environmental influences. Physical or mental stress may be the essential cause of psychotic behaviour in certain instances, but the nature of that behaviour will depend upon the reaction-type. Meyer uses the term " ergasia " to indicate the total behaviour of the individual. From this root word he constructs the following classification:

Merergasia—the usual psychoneurotic reactions.

Thymergasia—the primary affective disorders, divided into hyperergastic or other active manic states and hypoergastic or depressive retarded states.

Parergasia—the fantastic, incongruous schizophrenic states.

Dysergasia—the toxic delirious states.

Anergasia—with defect traits characteristic of the organic group.

Oligergasia—the group of constitutionally defective states.

The eclectics.—Dicks (1939), while accepting much of the Freudian doctrine, is at variance with the theory on fundamental issues. Instead of regarding the aberrations of the sexual instinct as the essential cause of mental abnormality, he finds that infantile fear is at the root of all repressions and psychopathological conditions. He points out that the importance of infantile fear is implicit in the nomenclature of other schools. For the psychoanalyst it is castration fear; for the individual psychologist it is the fear of insecurity or insignificance, for which abnormal compensations are sought. For the analytical psychologist it is the fear of advancing towards the next stage of development—imperiously demanded by the banished, because feared, unconscious.

In conformity with this view he postulates three main instinctive tendencies —the self-preservative, the sexual and the aggressive. Of these the first is the most fundamental and the earliest in its domination of the field. Fear and a feeling of insecurity, besides causing a deflection in the normal development of the self-preservative instinct, will also have repercussions on the other tendencies. Summing up, he states that " every patient with mental illness was more afraid than he could tolerate when he was a baby, and the faults in his psychic structure represent the gallant attempts to allay this intolerable feeling by the inadequate means at his disposal."

Concerning the body-mind problem and the part played by constitutional factors, heredity, physical type and endocrine disturbance, Dicks believes that the most useful conception is a monistic one. By this he means that the physical and psychical are different aspects of a unity—reality. The point of convergence towards this psychosomatic unity should be through a more

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thorough investigation of the mid-brain, automatic nervous system and the endocrine glands.

William Brown (1938, 1940), who borrows from a number of sources, postulates a large number of instincts, including sex, self-assertion and self-preservation, each with its own distinctive form of energy. Following McDougall he superimposes an organization of sentiments under the ultimate control of the sentiment of self-regard, which Brown prefers to call the love of goodness or eternal values. Any failure to obtain or maintain this hierarchy will result in dissociation of varying degree and in the formation of complexes. The dynamic side of the sentiment of self-regard is the will, and Brown agrees with Janet that many forms of psychoneurosis are due to feeble will-power. Re-education and constructive suggestion can improve will-power and so obtain psychosynthesis.

Murdo Mackenzie (1941) bases his psychopathology on a study of psychological types. He finds that people vary in what he terms their temperamental pace and value. Regarding pace, a man may be an Immediate or a Deliberate. The former will react quickly to a situation and, according to success or failure, will be described as brilliant or superficial; he is an opportunist. The latter reacts slowly to a situation, has a narrow range of interests and, according to success or failure, he would be labelled sound or dull. The second temperamental factor is value and here again there are two contrasting types, the Simplifier and the Amplifier. The former contracts the facts into a unifying principle; he is subjective. The latter orders the facts into a chain of evidence; he is objective. This provides four possible combinations which have much in common with Jung's extravert and introvert and their subtypes. Another feature, reminiscent of Jung's theory, is that, in a deliberate simplifier, the other two factors, immediacy and amplification, are not absent but are blocked. It is this blocking that causes persistent conflict and "primary nervousness." Mackenzie finds that there are four forms of primary nervousness corresponding to his four types. The depressive is a deliberate simplifier; the obsessive a deliberate amplifier; the hysteric is an immediate amplifier, and the assertive is an immediate simplifier. Regarding the assertive, Mackenzie explains that where there is marked mental arrhythmia, the anxiety phase of his assertives has been called mania by others, and the apathy phase, depression. Since assertives and depressives according to this theory are different psychological types, it is hardly surprising to find that Mackenzie denies the existence of the manic-depressive psychosis. On the other hand, he blames British medical psychologists for being so busy expounding the views emanating from the Continent that they have failed to notice the reaction of assertion, here described for the first time. He goes on to say that, with depression, this is the most common psychological illness met with in this country. Besides the above conditions, called "primary nervousness," the theory is further complicated by the fact that the same symptoms may be present as "secondary nervousness." For instance anxiety thinking may occur in any psychological type as a temporary event conditioned by the environment, and in primary anxiety the picture may be complicated by secondary depression or assertion. It would appear that it is these secondary features which, confusing the minds

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of other clinicians, have led to the isolation of the clinical entity, manic-depressive psychosis. Finally as a principal cause in the aetiology of primary nervousness, Mackenzie frequently finds a tendency to over-value the opposite types of thinking, and very often there has been a persistent attempt to think and react in the way that is opposed to the innate nature of the individual.

II. Phenomenology.

Amnesic syndromes.—In view of the fact that little has been published on the psychopathology of fugues, Stengel's theories on compulsive wandering (1939) and fugue states (1941) are of particular interest. His studies are based on a detailed investigation of 25 cases, of which 10 were related in some way to epilepsy, one was a schizophrenic, and the remainder were typical manic-depressives, hysterics and psychopaths. A feature common to the great majority of the cases was the tendency to periodical changes of mood, and in most of the female cases the onset of the fugue state was related to menstruation. The individual case-histories revealed one characteristic feature. The patients were persons during whose development there had occurred a serious disturbance in the child-parent relationship, usually of such a nature that relationship to one or both parents was either completely lacking or only partially developed. In some cases the patient had lost one or both parents during childhood, in others a parent had been absent for several crucial years, and in others again, though both parents had been present during childhood, the relationship had for one reason or another been particularly unfavourable. In the majority of patients the relationship to the parent of the opposite sex was disturbed. Another important factor was a constitutional or acquired tendency to react to various kinds of disturbance with an alteration of consciousness; besides the epileptics there were five typical day-dreamers, and fantastic pseudologia was present in eight patients.

The author concludes that there are three essential conditions without which fugue states do not develop: the tendency to indulge in periodic changes of mood, a disturbance of home conditions in childhood, and a tendency towards the production of twilight states.

It is to be noted that the author stresses the importance of lasting or transitory separation from one or both parents in childhood. Seventeen patients had lost one or both parents during childhood. In view of the fact that Palmer (1941) and Reitman (1942) stress the aetiological importance of this same factor in suicide, it is significant that 12 of Stengel's patients had made one or more suicidal attempts. Further, he thinks that the compulsion to leave home and wander aimlessly may mean dying in the deeper layers of the mind.

Sargant and Slater (1941) in a series of military neurotic casualties found a large number who presented an amnesic syndrome. Though epileptics, schizophrenics and cases of head injury were seen, the great majority were psychoneurotics. In about 25 per cent. the condition was precipitated by trivial concussion or dazing. Many had been subjected to severe stress—for instance, the Flanders retreat. Those without such a history were for the most part

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severe psychopathics, and in 83 per cent. of all the psychoneurotic cases there were indications of constitutional instability, some showing a specific constitutional tendency to disorders of consciousness. Two types of amnesic syndrome were isolated—fugue and retrospective memory gaps; the former were found to have more psychopathic traits. Those breaking down under stress were men of a simple, superficially calm, well-adapted, extraverted type of personality.

Anorexia nervosa.—Masserman (1941) studied a case of anorexia nervosa associated with neurotic vomiting, diarrhoea and character difficulties. The organic dysfunctions are shown to be somatic manifestations of a highly complex personality disorder arising from severe early emotional conflicts, especially in the oral sphere.

Anxiety.—Kubie (1941) approaches the ontogeny of anxiety from the Pavlovian viewpoint. He finds that anxiety is a reaction to a stimulus which has become conditioned to the "startle state." There is no evidence of the "startle state" or anxiety prior to birth, and it is therefore probable that the type of reaction to the "startle state" is determined at birth. There is not however at present sufficient evidence to show whether individual differences of reaction are determined physiologically, psychologically or in combination.

Rogerson (1940) provides an interesting paper on the relationship of anxiety to depression. This embraces the larger subject of the differentiation between psychoneuroses and psychoses, a problem that has already been considered in the first section and about which there is much controversy. Rogerson gives a very fair presentation of current opinion. His own view more or less coincides with that of Ross, who maintains that there is a qualitative difference between psychoneuroses and psychoses, and more particularly between anxiety and depressive states. Ross, however, is inclined to ignore the fact that depression is often a conspicuous feature in anxiety states, while anxiety is not uncommon in the symptomatology of depressive conditions—a fact that is stressed by Rogerson. Here, therefore, he falls into line with Gillespie, who postulates two types of depression, psychoneurotic with anxiety and psychotic without. Rogerson does not agree that the criteria for a diagnosis of psychoneurotic depression are to depend in the main on reactivity; in his opinion the differentiation should be based on the patient's relationship to reality. He finds that in the neurotic this relationship remains fundamentally intact, while the psychotic lives in a world of phantasy, and the mood change, once produced, pursues a course at least partly independent of the environmental problems. Rogerson would include many "agitated depressions" among his anxiety neuroses.

Rogerson's theory would seem to imply that the psychotic state must have an abrupt and fulminating onset with an immediate and total maladjustment to reality. If, on the other hand, the onset were insiduous, a slowly changing process in which contact with reality was gradually lost, then it is difficult to see how it would be possible for the subject not to pass through a phase comparable to that classed by Rogerson as a separate clinical entity.

Kozol (1940) studied the acute anxiety attack in a series of 48 cases from the psychobiological viewpoint. He noted that manifestations of autonomic nervous disorders usually involved both sympathetic and parasympathetic

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divisions, with some predominance of the former. The attacks appeared in a background of tension or chronic vague apprehension, but were not described by the patient as a mere exacerbation of these, but as something new. Regarding psychopathology, it was found that in the majority of cases the attacks were the end-result of a multiplicity of factors. Of these the most common single feature was insecurity, relating to affection, sex, marriage, health or economic status. Sexual difficulties played a role in four-fifths of the cases, and in nearly half were of primary importance. In early life the over-concern about the patient's bodily health on the part of an over-solicitous mother was frequently noted. Over one-third of the patients were " body conscious." The following personality traits seemed to be characteristic of the potential anxiety patient: egotism, hypersensitivity to the opinion of others, ambitiousness, aggressiveness, intensity and apprehensiveness. In only 5 out of the 48 was there no evidence of personal unbalance. In three-quarters of the patients there was a psychotic heredity; in about one-third there was a family history of anxiety attacks.

Palmer (1941) presents a paper on " attacks " which he points out are the meeting-place of the psychiatrist, neurologist and cardiologist. The psychiatrist refers to these as anxiety attacks; for the neurologist and cardiologist they are the vaso-vagal attacks of Gowers. Palmer prefers the term " vaso-automatic seizure." He describes a series of cases and concludes that these states form a continuum. At one end diathesis predominates, at the other psychic morbidity. Where there is a family or personal history of epilepsy, migraine, asthma or hay fever, where the attacks are occurring with a fairly regular periodicity, where the attacks are fulminating and punched-out in expression, and finally where the occurrence is more frequent than twice a week, it is assumed that the patient is diathetically predisposed, and that an intensive psychological approach is likely to be disappointing. In the predominantly psychogenic group the attacks may occur in anxiety states, phobic-obsessional states, hysteria and psychotic conditions. The point insisted upon in this paper is that it is essential to maintain the psychobiological approach in these cases, and to estimate carefully the relative degree of importance of diathesis and psychogenesis in the aetiology, for the former will not respond to psychotherapy.

Schilder (1941), in agreement with other psychoanalysts, is impressed by the importance of aggression in the psychological structure of the anxiety states. He points out that during the whole course of ego development the love object is not only a protection against deprivation, but is also feared as a possible aggressor. It is from this fear that the anxiety state may arise. Schilder thinks that the different types of anxiety neurosis can be classified according to the quality and structure of the aggressiveness:

" In the first group of cases the aggressiveness is directed against the love object as a whole. There is a tendency to wish the loved and hated person dead. . . . Cases of this type may be agoraphobic or may suffer from a fear of sudden death. Space is measured as the distance from the love object or from the place which symbolizes the love object. Pregenital sexuality does not play an outstanding part. . . .

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" In the second group of cases the hostility does not tend merely towards the removal of the love object, but seeks a more far-reaching destruction. The anxiety attack leads to a fear of being dismembered. The love object appears as someone who threatens to push the subject into an inferior position. Pregenital sexuality becomes more important. Obsessional trends are more pronounced. Claustrophobic elements may also be present. There are more severe distortions of space. The fear of going insane may become more important.

" The third and last group puts the theme of dismemberment in the foreground. There are severe distortions of space. Violent impulses are more outspoken ; pregenital sexuality plays a still more important part. . . ."

Schilder also finds that anxiety may have its origin at various levels of ego-development. In early childhood it will react with anxiety when its supply of food is not assured. It will react in the same way if threatened by loss of equilibrium and by the physical forces of gravitation, for at this stage of development the love object represents among other things a safeguard against falling. The relationship between anxiety, clinging and equilibrium is the subject of an important paper (1939) by the same author. The main points of Schilder's theory are inserted here.

It is noted that clinging may take place by means of the mouth to the nipple or by means of the hands to the breast, hair or other parts of the body. Its aim is to secure equilibrium and support by union or reunion with the mother's body. The child will respond with anxiety or panic if he feels uncertain of being able to maintain his position. As he develops and in the favourable case he will acquire the necessary confidence to maintain his posture alone. If however he fails to acquire this self-confidence and continues to cling to the love object, his dependence will sooner or later be felt as a compulsion, with consequent aggressive feelings towards his supporter.

At a slightly later stage in development anxiety will be aroused in response to the idea that the inside of the body is threatened with destruction. This is related to the child's own aggressive impulses directed against the bodies of other people. At this level fear of dismemberment in general will become important and later, with the awakening of genitality, this will culminate in the theme of castration. Schilder also finds that different types of anxiety are associated with different attitudes towards death. Where there is only moderate aggression death will only mean separation from the love object ; where there is deep regression the idea of death may be associated with fears of dismemberment and annihilation.

Caner (1940) shows how fear and anxiety may stimulate superstitious self-protection, and that these symptoms may have the unconscious purpose of obtaining protection through propitiation. The superstition that misfortunes occur in groups and that good fortune will be followed by bad fortune are grounded in the belief of primitive man that misfortunes are caused by hostile gods and spirits. The idea that the powers that control fate may be moved to pity and mercy by suffering is present in the unconscious of most people. It has led to an unconscious mechanism of self-protection through suffering, and may express itself in pessimism, worry, puritanism, excessive mourning and other

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neurotic and psychotic symptoms. In the author's opinion this mechanism is especially to the fore in biogenic depressions. Here the physiologically determined depression itself acts as an intangible and sinister threat against which the patient is unable to protect himself except by the mechanism of propitiation.

Body-scheme.—There is much evidence in favour of the view that each of us has, at the fringe of consciousness, a plastic and tridimensional bodily schema. This body image is built out of various perceptive elements, including superficial and deep sensibility, the sense of vision, and the vestibular sense. In a recent monograph (1939), Lhermitte, besides reviewing previous contributions by Head, Schilder and others, provides an authoritative study of the origin and nature of the body image, its deviations from the normal under certain morbid conditions, and finally its possible neuro- and psychopathology.

In the first chapter he traces the development of the body image in the child. By the age of nine months the child has learnt to distinguish self from non-self, but it is not until the age of two that he has learnt to appreciate the self as a unit. Play is found to be a most important factor in helping to form the body image. Lhermitte considers it unlikely that the image is fully developed until the age of eight.

Much of the author's evidence is derived from a study of the phenomenon of the phantom limb, a subject upon which he has previously made important contributions and which are incorporated in this monograph. Besides the well-recognized phantom limb of the amputated, a number of case-histories are presented in which the same phenomenon is met with in those suffering from various lesions of the central nervous system. Lhermitte favours the central rather than the peripheral theory of origin, maintaining that the body image is intimately associated with the cerebral cortex, more particularly the inferior parietal, marginal and angular gyri.

Besides the mutilations and distortions which portions of the body image undergo in cases of phantom limb, under certain morbid conditions the whole image may be projected into space as the illusion of a double. The more usual type is the external illusion, but a few are cases of internal illusion. Here as a result of a disorder of the coenaesthesic and visual senses, the patient believes he sees in front of him his viscera as if on a dissecting table. The illusion of a double may occur in normal people by a process of introspection, and under abnormal conditions such as the hypnotic state and in intoxication. More evidence is obtained by a study of psychopathological personalities. Here besides personal investigation of psychotic cases, the experiences of Goethe, Maupassant, Musset, E. A. Poe and others are reviewed.

Lhermitte believes that the fundamental psychopathological condition is a state of dissociation between the conscious, volitional and observing ego on the one hand and the physical ego, represented as the bodily schema on the other. In many cases closely allied to the illusion of doubles there is a failure to locate the conscious ego in space. To the subject it seems as if the observing ego is located outside the body, which it is able to watch as an automaton.

Teitelbaum (1941) presented two cases of hysterical body image disturbance associated with symptoms of agnosia and aphasia. He also described four

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experimental cases, in which similar disturbance in the body image mechanism had been produced by means of the post-hypnotic suggestion that the patient would forget all about his, or the human body; or that he would forget the names of the parts of his or the human body. Teitelbaum finds striking similarities between the symptoms due to psychogenic causes and those due to irreversible organic brain disease. Despite this resemblance he thinks that these two types of disturbance occur on different levels of cortical function, and disrupt the psychogenic mechanisms involved by different means. Besides the hypnotically produced disturbances in the body image there occurred associated disturbances in aphasia, agnosia, and in the central perception of primary sensation. The degree and range of associated disturbance was found to be subject to wide individual variation. All cases, clinical and experimental, showed distinct disturbances in spatial construction. In the clinical cases the body image disturbances were found to be due to emotional problems.

Spillane (1942) also supports the view that disturbances of the body schema are sometimes associated with an organic lesion of the brain. The degree of disturbance depends not only upon the localization of the lesion, but also upon which side of the brain is affected, lesions affecting the left side being associated with more severe disturbances. In a case with lesion of the right thalamo-parietal region there was unawareness of left hemiplegia, periodic forgetting of the left arm or leg, and a disappearance of the left side of the body from consciousness. Hallucinations of sensation with transference to the normal side also appeared.

In a case of a lesion of the left parietal-occipital area there were disturbances of both sides of the body. There were confusion of right and left and finger agnosia. Often there were agraphia and acalculia. Spillane believes that the coincidence of finger-agnosia, acalculia and agraphia may result from proximity of cerebral localization and/or because there is some deep similarity between them.

Few among recent investigators have made a more exhausting study of the body image than Schilder; in his last paper (1942) on the subject he studied the manifestation as it appears in dreams. He finds that as a rule in dreams the body image appears in infantile form and symbolically disguised, even when it appears also in the manifest content of the dream.

Capgras' syndrome.—In 1923 the illusion of doubles was first described by Capgras. Subsequently a number of cases were reported in the French periodicals and the condition became established as Capgras' syndrome. Various theories have been put forward to explain the psychological mechanism at work, and these are shortly summarized by Davidson (1941).

This writer presents two male cases, and concludes that the illusion of doubles signifies a denial, negation or rejection of a person or persons, because they are the centre of psychological conflict. As a mental phenomenon the illusion belongs to the projecting and identification mechanisms. The degree of its expression depends upon the resources of the total personality and the degree of disturbance of affectivity. He further finds that there is always some regression to a magic form of thinking.

Catatonia.—Melici (1942) points to the similarity between catatonia and

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the instinctive immobility reaction exhibited by certain animals confronted with a life-threatening situation. He suggests that this reflex is seen in catatonic patients who hide in corners, and where negativistic behaviour is clearly a rejection of the outside world. A more complete rejection, catatonic stupor, is described as a feigning of death to escape a disagreeable reality. He believes that the constitutional make-up, the catatonic reaction type, is the most important aetiological factor, and that under stress, physical or chemical but usually psychical or social, this form of evasion of the life situation will take place.

The author believes that there may be in some cases a conscious rational motive—that is, that the catatonic deliberately regresses to a phylogenetically older mechanism. It is further noted that there are striking similarities between stupor, sleep and death. All three can be considered flights from burdensome life. Normal sleep is a regression, and at the onset of psychosis there is often an increased desire for sleep. Melici regards catatonic stupor as a form of psychological suicide. The author makes no mention of anergic and hysterical stupor, to which his psychological theory would appear to apply more aptly. A study of his case-histories rather suggests that some of his "catatonics" may have been melancholics. There is a good deal of evidence in favour of the view that the catatonic is a physiological more than psychological reaction type, though the latter may play its part in some cases.

"Dejà vu."—According to Oberndorf (1941), the "*déjà vu*" phenomenon arises when the present situation has an associative link with some past experience or occurrence for which the individual is amnesic. This forgotten incident had been the centre of psychological conflict and consequent repression. "*Déjà vu*" is in fact a defence mechanism and is, in Oberndorf's experience, always associated with an unpleasant feeling tone. Analysis shows that the forgotten experience is invariably one of uncertainty and failure. The "*déjà vu*" reaction serves to reassure the individual against this insecurity; it is no new danger; it has happened before and he has survived. The phenomenon is common in young persons, and not uncommon in the normal adult. In the psychoneurotic it is frequently associated with other more distressing symptoms—depersonalization and feelings of unreality. These last have the same psychopathology as "*déjà vu.*"

According to Freud and Ferenczi, "*déjà vu*" is a response to an Id wish which, provoked by a real situation, emerges and causes the unconscious ego to defend itself against it. In place of the repetition of an unconscious fantasy appears the sensation of "*déjà vu.*" For both Freud and Ferenczi the Id impulse is primary. In contrast to the Id type of "*déjà vu,*" Bergler (1942) describes two examples of what he calls the super-ego type. In this type the unconscious ego defends itself against a reproach of conscious by means of "*déjà vu.*" In both the Id and super-ego type the identity of this repressed fantastical experience is replaced in consciousness by the identity of the apparently real situation.

Da Costa's syndrome.—Da Costa's syndrome is usually described as being characterized by a "certain group of symptoms which unduly limit the subject's capacity for effort, and by a number of signs depending upon disturbance of

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the automatic nervous system, when such symptoms and signs are not due to any known organic disease." Having enumerated the cardinal symptoms, Wood (1941) points out that this definition pays no attention to the psychological aspects. In his opinion the clinical features of the syndrome more closely resemble those of emotion, especially fear, than those of effort. In this connection it is noted that "effort syndrome in the male soldier becomes cardiac, respiratory or other neurosis in the female civilian." Wood believes that emotion, usually fear, acts as a central stimulus, provoking the somatic symptoms. The syndrome does not depend upon hypersensitivity of the peripheral autonomic system. Various factors relate the syndrome to effort. These include misinterpretation of emotional symptoms, certain vicious circle patterns, the growth of a conviction that the heart is to blame, consequent fear of sudden death on exertion, conditioning and hysteria. Incapacity tends to be exaggerated consciously or subconsciously in order to protect the individual from further painful emotional experience. Since a proper psychiatric diagnosis is nearly always available, it is urged that the diagnosis "effort syndrome" should be dropped.

Wood provides a large series of cases to demonstrate his hypothesis, and the evidence of emotional factors as the cause of the condition is overwhelming. A careful study of cases described as constitutional, induced, post-infective and physically fatigued types proved that such subdivisions were meaningless. In all cases the essential common factor was the emotional reaction.

If, however, it is clear that physical factors are not a cause of the effort syndrome, it has still to be shown that such a psychological mechanism cannot or does not produce irreversible tissue changes, as is believed to be the case in many other psychosomatic syndromes. If such were the case it would be likely to occur in just those patients who did not come for treatment until organic changes had occurred. Lastly, Wood offers no satisfactory explanation as to choice of organ, and unless a psychoanalytic explanation is accepted, it would appear necessary to postulate a constitutional organic predisposition.

Depersonalization.—According to Wittels (1940) the normal young person makes use of the mechanism of identification in the formation of his personality. He forms within himself a varying number of phantom figures; an ideal or ideals are set up which he more or less successfully imitates.

In cases of depersonalization an unusually great number of phantom figures are set up, leaving the ego in such a position that it cannot decide which one of the figures has to be acknowledged as its representative; in other words insufficient ego libido is invested in any one of these phantoms.

Wittels finds that in all cases of depersonalization the genesis of the condition can be traced back to an unsatisfactory father-child relationship. It is therefore the super ego, the representative or phantom of the father which cannot be satisfied, which, by condemning all the phantoms as unreal, is responsible for the disintegration of the personality.

Brock (1942) concludes that depersonalization and derealization are symptomatic of disturbance at the highest levels of consciousness. They may occur in a number of conditions, some cases being ascribable to psychogenic, others to organic causes. Regarding the latter it is noted that depersonalization is

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closely related to "*déjà vu*"—a condition which, he states, is known to be due to organic disease of the temporal lobe.

Dys-symbole.—As a result of his work with shock therapy Skottowe (1939) finds that there exists within the schizophrenic group at least three subgroups, which call for differently arranged and proportioned forms of therapy. The first of these types is characterized by dys-symbole, defined as a "state of mind which manifests itself by the inability of the patient to formulate his conceptual thoughts upon personal topics, or to discriminate the gradations of his emotions in language which is intelligible to others, notwithstanding that he may be in a state of clear consciousness, while he still retains word-utilizing ability at the level of perceptual thinking and so is not aphasic in terms of sensorimotor neurology."

The second group, dyskinesic, is taken to mean a disorder of motility of such a nature that the movements are fragmentary or incomplete and appear to be purposeless, although not without conscious concomitant, when considered in their environmental setting and in relation to the content of thought.

The third group, simple paranoid thinking, is applied to cases without difficulty of formulation, and in a clear intellectual setting. They are therefore to be distinguished from the more complex paranoid states, which are really florid manifestations of dys-symbole.

Skottowe maintains that shock therapy may at best clear up the florid symptoms in the first group, but it leaves the essential psychopathological change, dys-symbole, untouched. The dyskinetic group do well with shock therapy; improvement is certain and recovery is probable. The simple paranoids become more accessible with shock therapy, and if it is adjuvated by psychotherapy a good result may be expected.

Thomas (1940) goes further still. He confirms dys-symbole as a valid clinical sign and suggests that it is pathognomonic of true schizophrenia. He thinks there is much to be said in favour of a reversion to the older term "primary dementia" for this psychosis, in order to differentiate it from anomalous schizoid states of different quality which are often labelled "schizophrenia." He also finds that dys-symbolic cases do not recover with insulin or convulsant therapy, although the more prominent symptoms may be temporarily relieved.

The present writer is by no means convinced that the concept dys-symbole adds anything to our knowledge of schizophrenic thinking, or that it represents an advance on the work of Stransky, Bleuler and Storch.

Exhibitionism.—Rickles (1942) is of the opinion that exhibitionism may be a separate entity as well as a symptom of another disease. The same is true of any anti-social act—for instance fire-setting or stealing. He suggests the following classification: (1) Depraved—including all cases where the exhibitionist has carnal knowledge as his intent; (2) psychotic—where the act is only a minor manifestation in the pathological behaviour of a paralytic, epileptic, senile, or alcoholic; (3) expomania—where the act is the paramount symptom in an otherwise healthy personality. In these last the exhibitionism is due to a compulsion neurosis. He finds marked Oedipus fixation, and poor heterosexual and economic adjustment, the last despite a high educational

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and intellectual standard. Most of his cases had a pathological degree of repression and responded well to psychotherapy.

Fetishism.—Payne (1939) finds that the fetish is over-determined, being dependent upon a number of factors. In her opinion the fetishist is dominated by castration fear and she traces this fear to pre-genital causes, the chief of which are repressed sadism, and fixation at the oral and anal stages. Freud's view that the fetish is a defence mechanism against homosexuality is hardly touched on. Instead, there is, in the Klein tradition, much discussion of orally incorporated part-objects and of projection-introjection mechanism.

W. H. Gillespie (1940) provides a much more balanced psychopathological theory. He agrees with Payne on the over-determination of the fetish, the importance of castration anxiety, sadism and introjection-projection mechanisms. On the other hand, he criticizes the tendency to regard all symptoms from the oral and anal levels. He finds that superficially obvious oral and anal features are often used to mask more important underlying phallic anxieties. He also reminds us that it is castration anxiety we are dealing with, not the trauma of weaning. He confirms Freud's view that the essential mechanism is one of defence from sexual inversion, and that the castration anxiety means to the fetishist a talion punishment for incestuous wishes directed towards the mother.

Folie à deux.—Deutsch (1938) studied four cases psychoanalytically. For this school the mechanism of identification plays a most important role. The delusional idea of one person, it is contended, will only be taken over by the induced when there already exists in the latter a repressed phantasy life of similar content. Such a phantasy will concern the Oedipus situation, and the inducer will be identified, in the mind of the induced, with the parents, whose place in the original phantasy he takes over.

Last and Coleman (1939), in citing three instances, consider that a number of contingencies must be present at one and the same time. An inducer holding a delusional scheme which he is anxious to induce. It is essential that he should still be at the resilient stage; that is he must not have come in for so much hostile criticism as to have resulted in total withdrawal into himself. Again, his delusional system must not be of so personal a nature and so inelastic as to present no pragmatic solution for the personal problems of another individual. There must be in close proximity for many years a suggestible individual of the hysterical type, capable of taking over the delusion. Here again the ideas which the inducer wishes to propagate should be acceptable to the lifeline and wish-fulfilments of the induced. As has been generally agreed, the inducer, in some way or other, must represent authority. It is noted that extreme poverty is the ground upon which folie à deux flourishes. Page (1942) supports these contentions.

Gralnick (1942) provides the most exhaustive study of the condition. The literature is reviewed and a table appended which represents all the cases (102) reported in English, the author himself describing seven examples. As a comprehensive term " the psychosis of association " is preferred to folie à deux, which is considered to limit the clinical entity in a number of undesirable ways. The usual four subtypes are recognized: Folie imposée, simultanée, com-

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muniquée and induite. Of these the imposed type is the most common (61 out of 102 cases), followed by the communicated type (24 cases). The frequency of combination is: Sister-sister (40 cases), husband-wife (26 cases), mother-child (24 cases), and brother-brother (11 cases). The following reasons are put forward to account for the fact that folie à deux is more frequently found in women: they tend to be more isolated within the domestic circle; they are, on the whole, more passive, submissive and suggestible; their outside interests and ambitions are more likely to be restricted or frustrated. The evidence, according to the author, does not go to prove that a constitutional predisposition is a significant factor. The importance of identification is stressed in the mechanism of folie à deux. Paranoid delusions are found to be preponderant, and the aetiological significance of homosexuality is discussed.

Oatman (1942) presents a case in identical twin-brothers. His example illustrates some of the points stressed by other writers, viz.: the illnesses in the two brothers showed resemblance to a remarkable degree; they had led an isolated life for a number of years; one brother was clearly the aggressor, while the recipient was of a neurotic make-up and fertile ground for a psychosis. Though the author admits that communicated insanity may occur in three, four or even five persons, he insists that the term cannot be applied to larger groups who "adopt the religious or pseudo-philosophic delusion of their self-appointed leader." Unfortunately Oatman does not back up his statement with an explanation. It would be interesting to know what new motives or mechanisms are introduced when the specific number of five has been passed.

Hallucination.—Maclay and Guttmann (1941), in a further attempt to throw light on the physio- or psychopathology of hallucinations, have made a study of visual hallucinations during mescaline intoxication. Some of the pictures, representing the visions, were characteristically formal and repetitive and could be accounted for entirely in physiological terms; in others there were many features representing the free play of phantasy. The authors conclude that hallucinations during mescaline intoxication cannot be explained in either physiological or psychological terms alone. It is further pointed out that these conclusions cannot be applied to other hallucinatory conditions without further study.

Impulsions.—Bender and Schilder (1940) describe a condition peculiar to children and closely allied to compulsions and obsessions, which they call impulsions. In these cases specific interests, ideas and actions dominate the clinical picture and make social adaptation impossible. The symptomatology comprises continuous looking at and handling of a specific object; drawing of the object; preoccupation with the object in fantasies or in thoughts; excessive walking; counting and preoccupation with numbers and space. The subjects insist upon immediate fulfilment of their wishes and cannot stand any frustration. The patients are stubborn, show hypochondriacal preoccupations, and may use asocial means to satisfy their strong desires. The authors found these symptoms in boys between the ages of four and twelve.

Impulsions differ from compulsions and obsessions in that in the two last the subject protests against his thoughts and impulses. This is not so in the

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case of impulsions, which are characteristic of childhood, where the ego-super-ego system is comparatively inefficient. The condition may pass on to obsessions or compulsions in later life. Impulsions take their origin from early infantile situations and desires, and can be compared with the preoccupations of infants under two. They are never direct expressions of sexual and aggressive drives, but are always related to the family situation, and are, therefore in many respects, the result of transformations and symbolizations.

Insight.—Insight is a very valuable concept, especially as far as prognosis is concerned. It is however, as is clearly demonstrated by Campbell (1940), most difficult to evaluate. Insight and judgment, it is shown, are an exact index of each other and involve similar mental function. According to Campbell, insight is concerned primarily with the awareness of psychological change; secondarily, with the judging of this change, as to whether it is recognised as morbid; or in a sick mind the change may be judged to be the result of demoniacal possession, religious influence or other preternatural intervention. In any mental disorder it is with the whole disordered personality that the patient contemplates his state or special symptom. Insight is therefore bound to be distorted in one contributing function or another. In certain cases, it is shown, statements superficially indicating insight are the most outstanding features of the psychosis, and far from indicating insight are a result of severe disturbances of affect, such as severe anxiety, self-reproach or hysteria. Typical examples are such remarks as "I must be mad" or "I ought to be in an asylum." It is therefore concluded that insight is only relative, and should never be stated categorically but only with appropriate explanatory terms.

Osgood (1940) studied the insight of 100 patients discharged from hospital. He found that of those diagnosed depression on admission there were a greater proportion of patients who showed good insight on admission than among those with other psychoses. Psychoneurotics all showed fair to good insight. He found that absence of insight on admission did not impair the prognosis for recovery, but patients with partial insight showed a poorer recovery-rate than either those with no insight or those with good insight.

Psychosomatics.—During recent years considerable evidence has accumulated to suggest that certain physical disorders are determined to a varying extent by psychological factors. The experimental work of Pavlov has had undoubtedly an important influence on this line of research, even though the Pavlovian theory itself pays little attention to psychological phenomena. Both psychobiologists and psychoanalysts have studied this subject, and their contributions will be reviewed in turn. The two schools differ in the main in their explanation regarding choice of organ. According to psychoanalysts, psychological factors are all important, while psychobiologists include other determining factors. The approach of the individual psychologist has been discussed in the first section.

Noyes (1939), for instance, stresses that while the constitution is the most important single factor in deciding the choice of organ, psychological factors may also play their part. These include the nursing of a near relative with a specific organic disease and overvaluation of an organ on account of occupation.

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Noyes makes some attempt to differentiate between the types of psychosomatic disorder. His first group includes those organic disorders which are secondary to psychological stress. The psychological stress produces anxiety, which in its turn causes dysfunction of the endocrine-automatic system. The next group includes organic diseases and accidents, in which there is an overlay of psychotic symptoms on account of the disability, financial loss or compensation factors. Finally there is the pseudo-organic symptom of the hysterical type, which has an underlying emotional conflict and in which the symptom has a symbolical meaning for the subject.

Fox (1942) thinks that the greatest danger in studying psychosomatic states is the fundamental habit of viewing body-mind problems as dualistic, instead of as a psychobiological entity. It is equally unfortunate for the patient whether the over-emphasis be laid upon the physical or the psychical sphere. In a series of cases Fox attempts to demonstrate that the bodily parts and functions should be included in the biographical stream according to their symbolic participation in the life of the person. Choice of organ in psychosomatic disease may be determined in two ways. First the organ may act as a symbol referring to a special experience—for instance, vomiting because of disgust—and secondly the organ may act as "symbolee"—that is, the object symbolized, for instance, where a patient states, "He makes me sick."

Jelliffe's monograph (1939) presents the psychoanalytical point of view. His general theory is that as a result of mental conflict and repression in certain neurotic types libido becomes fixated upon a particular organ or system. At first this process is reversible and is called an organ neurosis. Later, as a result of prolonged faulty adaptation, structural changes will occur. The condition is now irreversible—organic disease. Jelliffe illustrates his theory with numerous case studies, which include skin lesions, arthritis, hyperthyroidism, cardiovascular disorders, gastro-intestinal conditions, asthma, pulmonary tubercle and disease of bone.

Notkin (1941) provides a useful review of the principal contributions during the years 1933 to 1939. He believes that a conscious or unconscious unpleasant emotional stimulus reaches the thalamus. This induces prolonged overactivity of the autonomic system. This overactivity, in its turn, causes over-stimulation of the end-organs and consequent dysfunction—organ neurosis—and passing on finally to structural changes—organic disease. It is not made clear if the choice of organ is constitutionally determined, or depends on psychological factors.

It may now be in place to examine contributions on specific psychosomatic syndromes. Da Costa's syndrome and speech disorders will be found under separate sub-titles.

Miller (1941) presents four cases of cardiac disturbances deriving from emotional stress. It is shown that the symptomatology is often patterned after parental disabilities, and that at a deeper level, the parent of the same sex is represented as a powerful adversary towards whom the patient was impelled to adopt an aggressive attitude. This aggression is compensated for by guilt, fear of losing parental love and self-punishment by means of the cardiac symptomatology. Herrmann (1942) concludes that disturbances of

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psychogenetic and neurogenetic origin make up from one-third to one-half of all the disorders in cardiovascular consultant work. Weiss (1942) emphasizes the multiple factors in the aetiology and pathogenesis of essential hypertension. He stresses that while the physical problems should not be neglected, the emotional component is intimately related to its development. Although all varieties of character and neurotic disturbances occur in hypertensive individuals, he finds that a common problem appears to be the presence of emotional tension due to chronic repressed hostility. In his opinion this inhibited aggression (chronic rage) bears a specific relationship to hypertension.

French (1939) made a study of a series of cases of bronchial asthma. He concludes that psychological and allergic factors stand in a complementary relationship to each other in the aetiology of this condition. In some cases asthma attacks are precipitated by allergic factors alone, in others by emotional factors alone, and that in still other cases co-operation of allergic and emotional factors may be necessary to produce attacks. Regarding the emotional factor, he finds that asthma is precipitated by a temptation which threatens to estrange the patient from a mother figure, and that the personality of the asthmatic is built up in a large part around the task of mastering by one means or another the fear of being separated from the mother. In some cases it was found that the substances to which the patients were allergically hypersensitive proved also to play a role in their psychological material—that is, the substances had a symbolic meaning associated with the essential emotional conflict.

Basing his conclusions on a large series of cases, Morrison (1942) describes a distinctive psychosomatic ulcer pattern manifesting itself not only in the duodenum, but also in the digestive tract and in the constitutional behaviour of the patient. This pattern is characterized by hypersensitivity, hyperirritability and hyperactivity. He is of the opinion that psychological influences may represent an aetiological factor, though the mechanism requires further elucidation. Wilson (1939) made a study of 50 haematemesis patients, and found that they can be divided into several psychological types. The main group of about half the patients suffered from obsessional anxiety states or corresponding character disorders. The second group, about one-fifth, showed, in addition to obsessional features, hypochondriacal and hysterical phenomena. An intermediate group had shown a change from a predominance of hysterical to a predominance of obsessional reactions. Single examples of two other types are described. Common to all his patients was an abnormally high need of security. In the history of their sexual development and in their social relationships all showed evidence of emotional immaturity. Their reaction to illness and stress was with depression and the compulsive form of anxiety. From an examination of the precipitating situations it is concluded that patients with this disorder are hypersensitive to problems of security, independence and responsibility. In the majority of cases it was evident that a self-punishing tendency was finding expression in the gastric disturbance; only in the hypochondriacal group was evasion of responsibility the unconscious motive. In other words, the anxiety was due to fear of conscience, not fear of the instincts. Wilson does no more than suggest that ultimately the abnormal gastric

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response to threats to security may arise as a late result of abnormal conditions during the period of development. Inadequate infantile histories prevented a verification of this.

Sleep disorders.—In an interesting symposium on neurotic disturbances of sleep, Fenichel (1940) sums up the psychoanalytic viewpoint. Relaxation is an essential concomitant of sleep and, in the neurotic, a state of tension exists. This state of mental tension is due to unconscious stimuli, which are not under the control of the conscious wish to sleep. Generally speaking, it may be said that the neurotic fears sleep because he knows that repressed impulses push forward with greater force in the state of sleep or falling asleep. Analysis reveals various psychological conflicts behind the fear of falling asleep; these include bed-wetting, masturbation and wet-dreams, memories of the " primal scene " and oral complexes. According to some of the writers of this symposium it is likely that oral instinctual conflicts are a *sine qua non* for all severe sleep disturbances. Melancholia, it is pointed out, where orality and super-ego dominance are paramount, goes hand in hand with the most serious disturbance of sleep. Besides fear of temptation the neurotic may be prevented from sleeping by fear of his conscience and of punishment. As a rule both fear of temptation and punishment are present together. As is well known, immediate conflicts and difficulties, the day's residue, will interfere with normal sleep, but it is only when these become linked up with repressed material that neurotic insomnia is induced. The other papers in this symposium are of considerable interest, but are more concerned with analysis of individual cases, *pavor nocturnus* and insomnia in hysteria anxiety and obsessional states, rather than general psychopathology.

One of the most interesting disorders of sleep is what has been termed the " narcoleptic-cataplectic syndrome." The syndrome consists of a number of constituents, one or all of which may be present in the same individual, but which are believed to have a common psychopathology. There have been several papers on the condition in recent years. Brock and Wiesel (1941) define narcolepsy as a type of irresistible sleep or a trance-like state which may correspond to the polyphasic sleep seen in lower animals and infants. It is indistinguishable from normal sleep, save that it may occur under circumstances not usually conducive to sleep. In cataplexy the individual undergoes a partial or complete atonic deposturing, most frequently in reponse to emotional reactions. He is in complete control of his mental faculties, but manifests all the physical attributes of deep sleep. It may be followed by " mental " sleep. Sleep-paralysis (Wilson) is similar to cataplectic paralysis, but follows or precedes normal sleep or narcolepsy. Somnambulism and somniloquism are often found in these individuals. A further constituent is sleep-hallucinosis, where fearful dreams are experienced in the hypnagogic state before or after normal or narcoleptic sleep.

Brock and Wiesel support the view that sleep is composed of two parts, the mental and physical. In the narcoleptic-cataplectic syndrome there is an excessive and dissociated reaction of the sleep mechanism, composed of a number of constituent parts (*vide supra*). The fundamental cause of the syndrome is unknown, but these authors favour the view that it is an organic

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disease. Again the area of the brain involved is a matter for speculation. One of the two cases of sleep hallucinosis, here described, subsequently developed a paranoid hallucinatory psychotic state on the basis of the abnormal dream content. They also note the resemblance of these conditions to hysteria. Lichtenstein and Rosénblum (1942), discussing the psychopathology of sleep paralysis, agree with Pavlov that it is a manifestation of localized sleep; the motor centres are "asleep" while consciousness is awake. They consider that when it accompanies natural sleep it is a benign condition, and they advise that the patient should be assured that it has never been known to result in permanent paralysis or other form of disease. No view is expressed as to its organic origin. Murphy (1941) concludes that narcolepsy is a border-line syndrome common to cases of both functional and organic brain disease. The pathogenesis is the same in both cases, and consists of the release of a primitive type of sleep mechanism. Narcoleptic sleep is indistinguishable in appearance from normal sleep. Levin (1942) presents a case in which forgetfulness and difficulty in learning were associated with narcolepsy. He concludes that the presence of such symptoms, often not observed, supports the theory that narcolepsy is due to cerebral inhibition. Hadley (1942) describes a case of narcolepsy in which a diagnosis of glioma was made by ventriculogram. The glioma was removed, the pressure symptoms relieved, but the attacks of narcolepsy persisted. He considers the glioma to have been coincidental. The various theories, functional, cortical, diencephalic, symptomatic of gross brain lesion and endocrine are reviewed without comment. In the present state of our knowledge this is probably the safest attitude.

Speech disorders.—According to Bender (1942), experimental evidence of the personality of post-pubertal male stutterers, i.e. morphology, mental capacity and temperament, indicates that they have characteristic aspects of personality.

In the more stable aspects, e.g. physique, blood chemistry, the evidence is the strongest. For instance, it is found that the body build is leptosomatic and never pyknic. In the less stable aspects, e.g. intelligence, perseveration, the evidence is significant. Stutterers are found to be afflicted characteristically with perseveration and to be more intelligent than non-stutterers. In the least stable aspects, e.g. temperament and personality traits, the evidence is not so strong as in the other two. It is found that stutterers are more emotional, more introverted, less sociable, less dominant and less self-confident. It is thought that the stuttering personality traits of the last group are a result and not a cause of the affliction. Greene (1942) points out that the majority of so-called functional conditions are not speech or voice defects in the usual sense of the term, but are merely peripheral manifestations of some more serious underlying involvement. This is more particularly true of stuttering, which is defined as "a disorder characterized by repetitions or prolongations of syllables or words, or by mouth contortions, all of which produce interruptions and breaks in the rhythm of speech." He isolates clonic, tonic and mixed types. The last approximates to a localized epileptic fit, but the author is not prepared to say that there is a common cause.

Regarding the psychopathology of the stutterer Greene concludes that

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stuttering speech is a "somatic manifestation of an emotional disorder based on a definite psycho-biological variability involving the organism as a whole." Because there are certain characteristics common to stutterers as a group he is inclined to isolate a stutter type.

The stutter type demonstrates "a basic tendency towards excitability and disorganization, an exaggerated capacity for response to stimuli, and a relatively high potentiality for the spread of emotional tension. Their mental and physical activities are continually being disturbed or inhibited because of uncontrolled reactions. This disturbance is manifested (in psychosomatic performance) by arrhythmia and hesitancy, which is in fact a form of stuttering."

This hesitancy, besides expressing itself in speech, may also be shown in other voluntary activities and may also involve the automatic system. The exact mechanism underlying stuttering is unknown, but there is strong evidence of a constitutional factor predisposing to emotional instability. Over 50 per cent. of the writer's patients showed a family history of stuttering, and when other forms of psycho-somatic disorder are included the percentage is much higher. Greene believes, however, that stuttering will not occur in the absence of an active precipitating factor. There must, therefore, according to Greene, be three factors present before stuttering can occur—constitutional emotional hypersensitivity, a precipitating psychic trauma, and to determine the choice of organ an inherent weakness of the vocal mechanism.

Psychophonasthenia presents much the same problem as stuttering. It usually occurs in late adolescence and adulthood, especially in professional men and women. Patients complain of a tight, constricted throat and of an uncontrollable choking sensation while talking. "The voice is pinched and grating, and cracks frequently, breaking suddenly to another key or choking off completely." This condition also is of psychical origin, a symptom of neurotic anxiety—"anxiety which has been physiologized in the vocal tract." The onset can usually be traced back to some psychical trauma, though there had been in nearly all cases a neurosis before the voice symptom developed.

In hysterical aphonia, again, minor psychic conflicts are converted into vocal dysfunction. It is usually a negative reaction to some environmental situation which is distasteful or which threatens security or happiness.

Regarding "falsetto voice," Greene finds that in the majority of cases it is a neurotic manifestation of excessive sensitivity at the pubescent period. The popular stigma of doubtful sexuality is, in the majority of cases, undeserved.

In general Greene finds that while the stresses and strains of puberty may precipitate these vocal and speech disorders, the essential cause, personality and behaviour maladjustment, will be found to have been developing long before. He further associates the various speech disorders with specific personality types, given the other necessary aetiological factors described above. The nervous, emotionally hypersensitive, disorganized child will become a stutterer; the inhibited, fearful and seclusive child will develop psychophonasthenia; the timid, sensitive, effeminate child falsetto voice; and the flighty, hyperemotional type with temper tantrums hysterical aphonia.

Suicide.—In a series of 150 cases of suicide Siewers and Davidoff (1942)

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find that a large majority showed defective personality integration. About 20 per cent. were psychotic, and an organic disease was present in about 33 per cent.; in 29 no classification could be arrived at. More women attempted suicide, more men actually committed suicide. Successful suicide was more common in older people. Sex difficulties and lack of occupation were frequently encountered as factors in the aetiological constellation. The authors consider that attempted suicide is a manifestation of the catabolic phase of the life process. In this state the catabolic processes, including the psychological component, take precedence over the anabolic forces. The mal-integration of the personality or the occurrence of psychosis or physical illness, as observed in many of the patients, indicates the presence of a catabolic process which exceeds the anabolic. In advancing years and in senescence where the catabolic process is progressive and irreversible, the likelihood of successful suicide is increased. If this means that in the suicide the desire to die outweighs the will to live, it will probably be generally conceded.

Palmer (1941) made a study of 25 suicidal attempts. He finds that the alleged "cause" is at most only a precipitating factor, and that the essential motive is to be looked for in the early formative years when the structure of the ego and super-ego were being formed. He believes an arrest in psychosexual development to be the basic mechanism in a majority of suicidal attempts. This arrest is often due to the unavailability of one or both parents as love-objects, as "stepping-stones" in psychosexual development and as active forces in super-ego formation. The unavailability is usually due to death, but it may follow separation, divorce or social deterioration of one or both parents. In Palmer's series 16 patients lost a parent and one patient a sibling before the age of 14 years—a percentage of 68. Reitman (1942) also investigated 25 suicidal patients, and in his series the coincidence of suicide and early loss of a parent was established in 60 per cent. of the cases. Reitman admits that the numbers are too small to be of statistical value, but they do, however, support the probability of a prediction of suicide based on this fact.

In contradistinction to the general view, Prudhomme (1941) finds that the suicidal rate among epileptics is more than twice the mean rate found in the general population. His figures are those for Craig Colony for a period of 14 years. In his opinion, epilepsy is a psychobiological reaction type, the "fit" being considered a temporary escape mechanism. The epileptic, it is pointed out, often experiences a symbolic death in the "fit," and as a result much of the fear of death has been removed. The tonic and clonic stages represent symbolically an organismic struggle between the two basic instincts of life and death. It is suggested that such repeated episodes and the temporary relief that they bring prompt the epileptic to seek suicide as a final and complete deliverance from his troubled existence.

Pescor and Spurgeon (1940) made a study of the suicidal motive in 28 hospitalized drug addicts. As a result they were able to distinguish two personality types. The first group were genuine suicidal patients, and were men round about the age of 40. They had usually become addicted through physical illness many years prior to admission. Childhood adjustment, economic and domestic adjustment before addiction were all satisfactory.

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The suicidal episode, usually preceded by severe depression, occurred when the patient was no longer dependent on drugs. The second group were those who made a histrionic gesture at suicide. The average age was some ten years younger, and the history was that these patients had become addicted either from curiosity or association. Childhood, economic and social adjustment were invariably unsatisfactory. The patients were usually found to be largely dependent on illegitimate sources of income or to sponge on relatives and friends. Sexual adjustment was unsatisfactory, often with a leaning towards homosexuality. Many had a psychotic heredity and/or a history of previous mental illness.

In a less ambitious paper, which does not attempt to explain suicide, Thorner (1938) provides an interesting contribution to the subject in a study of two cases. What he shows very conclusively in his cases is that the choice of method is determined by the subject's phantasies. In the first case, with a wealth of phantasy about food and eating, poisoning is attempted. In the second case, where phantasies and fears regarding voice production predominate, strangulation is the method of choice.

War and psychopathology.—In the causation of mental illness the psychopathologist would very much like to know more about the relative importance of constitutional and environmental factors. From the point of view of theory it would be particularly interesting if it could be shown that severe mental stress, sudden or prolonged, such as is met with in war, could produce mental abnormality in a constitutionally healthy adult. As is to be expected, at the present time, there have been a large number of papers in which these and other psychopathological problems associated with the war have been investigated.

In *The Neuroses of War* (1940) E. Miller provides an excellent chapter on "Psychopathological Theories in War-Time." Actually there is only one theory, that of Miller, though this takes its origin from a number of sources. His thesis is that whether the instinctual apparatus is explained by reflex mechanisms or not, we must assume the existence of inborn needs which are the instruments for man's survival. Man's cultural achievements to some extent mask these needs, but the whole range of psychiatric and psychotherapeutic practice gives illustration of disorders in which hidden biological needs are not clinically obvious, but in which unsatisfactory adjustments to social and private needs are certainly inferred. In the war neuroses in particular there are conditions of life which frequently place an immediate and overwhelming strain upon the instinctive endowments. His main point is that though circumstances of war often allow considerable latitude to certain instinctive demands, this is offset by the fact that the individual soldier in the release of these urges must conform to a very strict pattern of behaviour. For instance, the instinct of aggression may have great opportunities for expression, but only under the restricting influence of discipline. Again, the instinct of self-preservation may be very much to the fore, but it must not override "retreat according to plan." The individual soldier comes into a war with a fully formed personality and individual mechanisms by which he reacts to difficulties. As to how he will conform to army regulations and discipline will

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depend upon the resilience of his personality, and upon whether he has built up defence mechanisms against stress that are within normal limits. Certain types, particularly the narcissistic and those troubled by guilt feelings, will find it especially difficult to fit in with military discipline.

Sargant and Slater (1940) made a study of men suffering from acute "shell-shock" following the evacuation of the B.E.F. from Dunkirk. They found that patients admitted between the outbreak of war and this episode had broken down under the comparatively trivial stresses of life abroad under army conditions, without any of the severe strains entailed in actual fighting. In these the past history in the majority showed personality deviations, constitutional instability and lack of stamina. On the other hand, the acute war-neuroses demonstrated that men of reasonably sound personality may break down if the strain is severe enough. Even in this group it was thought that there was an excessive proportion of men who had suffered from nervous trouble in earlier life—larger, that is, than would be expected from a sample of the general population. Therefore here, too, constitutional factors could not be denied. They conclude that while these men might have remained mentally healthy under normal strain, the excessive physical and mental stress to which they had been subjected was an important aetiological factor.

As compared with the last war, Hadfield (1942) is struck by the difference in the picture presented of the neuroses in hospitals in this war. The increase in psychosomatic disorders was to be expected, for the importance of psychological factors as a cause of gastro-intestinal, cardiac and other somatic conditions had not at that time been so fully appreciated. He also notes an increase in the number of patients labelled mentally backward and of the "psychopathic personality" group. The most striking change is the greatly increased proportion of anxiety states as compared with conversion hysteria. In Hadfield's series of psychoneurotics in this war, 64 per cent. were anxiety states and only 29 per cent. hysteria. He cites a number of possible reasons for this. In the first place there were far more traumatic cases in the last war; and traumatic experiences, owing to their physical accompaniments, are more likely to produce somatic symptoms of the hysterical type. Secondly, owing to this war being nearer to the home front, many chronic neurotics who should never have been recruited, and who in the last war would never have found their way to France, break down and are admitted to the neuropathic hospital. Hadfield regards these as "civilian" cases and not as true war neuroses. Finally this change in proportion may be due to the opposite fact, namely, that the air-raids have brought us nearer to the front line; and the evidence goes to prove that the nearer the front line, the greater the proportion of anxiety states compared with conversion hysteria.

Hadfield next considers how far these neuroses are attributable to, or how far they are aggravated by, war service. In his series of 332 patients, in 60 per cent. of the cases the neurosis had little or nothing to do with war service, whereas the other 40 per cent. could be regarded as war casualties. In 82 per cent. of 326 cases there was a predisposition of a constitutional or acquired type. However, in a more detailed investigation of 100 patients only three showed no psychological predisposition. He concludes that precipitating

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factors, even when as important as the traumatic experiences of war, seem incapable, except in a few cases, of producing a neurosis unless there has been predisposition.

Granting then that there is predisposition, Hadfield's next inquiry is as to the relative importance of constitutional and psychological predisposition. By constitutional he means innate, endogenous and dependent on the physiological and biochemical make-up of the individual; by psychological he means acquired and due to environmental conditions, especially in early childhood. The amount of predisposition was found to be about equal; of 289 cases, 49·4 per cent. were predominantly constitutional and 50·6 per cent. predominantly psychological.

Lewis (1941) employs the sampling method in order to estimate the incidence of neurosis in England under war conditions. His data were obtained from psychiatrists, clinics, general practitioners, medical officers of health and others. Some of the evidence is set out statistically; the rest is an expression of opinion. All the principal areas subjected to intensive air-raids are included. The conclusion arrived at is that air-raids have not been responsible for any striking increase in neurotic illness. There is, however, evidence to suggest that after intensive raids there is a slight rise in the total amount of neurotic illness in the affected area. It occurs chiefly in those who have been neurotically ill before. These reactions may not show themselves for a week or ten days after the bombing. They usually clear up readily. Anxiety and depressive states are the commonest forms of upset. The incidence has been low in civil defence workers. Statistical information obtained from the Board of Control indicates that insanity has not increased. If the war were producing an increase in mental instability an increase in drunkenness might be a sign of this. Lewis's figures do not suggest that there has been any striking decrease or increase in proceedings of convictions for drunkenness.

Hemphill's (1941) observations are based on the admissions to Bristol Mental Hospital during 1940. During the year that city was subjected to severe attacks by day, numerous minor and some "blitz" raids. Nevertheless it is found that the number of patients admitted showed a reduction on the preceding years. In only 29 out of 354 admissions was the war found to be even a minor contributory factor. Family or constitutional taints were found in most relevant cases. Hemphill concludes that the war has had little adverse effect on the mental health of the civilian population.

Glover (1941) provides an important paper on the psychological effects and immediate sequelae of air warfare on the civilian population. His data are based upon the experience of 20 analysts, who gave replies to a questionnaire. Three phases of the war are studied: (1) The Munich crisis, (2) the pre-blitz period, and (3) the "blitz." It is noted that statistically regarded the material was scanty and was selected mostly on the basis of private practice.

(1) From a study of reactions at the time of the Munich crisis the following conclusions were obtained as to the probable reactions of the civilian population when actual warfare supervened. It was found that unconscious and deep preconscious factors determine the quality though not the intensity of war-time reactions in the section of the population which for one reason or

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another requires psychological treatment. Despite the relatively scanty material, it is believed that the same can be said of the population at large. It is suggested that the reactions observed in pathological groups enable one to forecast, tentatively, the reactions of more "normal" groups. The findings suggested that, when actual warfare did supervene, the so-called normal population would show two distinct varieties of abnormal reaction. Ordinary people whose character is of an hysterical or neurasthenic type would react with varying degrees of anxiety or minor physical upsets; whereas those who have an obsessional, depressive or paranoid "make-up" would on the whole express their difficulties, not in the form of psychoneurotic symptoms, but in various types of social difficulty. These findings indicated that problems of civilian morale are not simply political or economic, but must be considered primarily from a medico-psychological angle.

(2) Observations during the pre-blitz year yielded few general conclusions. Clearly there was little justification for any very abnormal reactions., Such as did occur fell into the two same groups as the Munich reactions. Improvement in previous symptoms as the result of changed conditions was noted in both phases. The view that unconscious factors were the main determinants of such disturbances as did occur was confirmed. Again, the importance, as a precipitating factor, of changes in social setting was noted in both phases.

(3) In the "blitz" phase the following were the principal conclusions: The view current in official medical and administrative quarters that air-raids would give rise to widespread "war neuroses" proved to be a myth of an unconsciously apprehensive and appetitive type. As far as can be estimated, the actual incidence of pathological reactions to air-raids was no greater than might have been anticipated by a psychological assessment of predisposing and precipitating factors. Its apparently low rate was due to a number of reasons. Owing to the absence of trained personnel at the most suitable points a great number of cases were never observed or recorded. Many psychosomatic reactors were treated for "organic" illness. The predisposing conditions of civilian life were rarely so severe as those existing in the army. Only a very small proportion of the population in any raided area experienced severe traumatic conditions. Here again it was found that shock reactions could be divided into two main groups—anxiety, etc., and social reactions. The former group was divided into four sub-types: (*a*) major, corresponding to the classical "war neuroses"; (*b*) minor, qualitatively of the same type but usually capable of spontaneous resolution within a few days; (*c*) delayed; and (*d*) vestigial types. Although the two last presented definite "shock" features, the reactions were difficult to distinguish from those observed in the absence of real traumatic conditions. Social reactions met with were anger, resentment, grievance or aggressiveness, or reduced social capacity from undue passivity, confusion, lack of working capacity and of power of adaptation.

The actual traumatic factors most frequently observed were: (*a*) In severe cases, "near misses" and injuries and/or severe bombing over a long period; (*b*) in mild cases, severe blast, usually followed by some degree of physical injury. The predisposing factor most commonly observed in raid-shock was that of chronic mental disturbance. "Psychopathic" types (emotional instability,

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maladaptation, lack of working capacity, character peculiarities) reacted most severely. Given satisfactory transference conditions, many psychoneurotic cases preserved a considerable degree of stability. Psychotic types showed little reaction unless directly involved in a hit. Other important precipitating factors were: (*a*) In severe cases, death of relations or neighbours in the same raid; (*b*) in mild cases, grave or fatal casualties among strangers, and extensive damage of the room occupied. In both types the following additional factors were observed; old age, previous evacuation or break-up of the family, lack of friends, isolation, responsibility for children, lack of efficient shelter protection, poor anti-aircraft defences, social and economic insecurity. Certain post-raid conditions acted as aggravating factors: prolonged burial under debris, poor rescue organization, disruption of social services, inefficiency of welfare arrangements, splitting up of family, extensive destruction of houses or shops, disturbances of work, economic difficulties.

The following were some of the more important inferences: (*a*) In most cases the anxiety factor was decisive. Realistic anxiety was proportionate to the real danger in all except children, psychotics and those suffering from excessive unrealistic anxiety. Unrealistic anxiety was, relatively, most pronounced in areas bordering on raided districts. (*b*) The "psychic situation" underlying most anxieties was a disturbance of the existing balance of transference. (*c*) Those individuals most frequently, and/or markedly, affected belonged to the anxiety-character group, the so-called "narcissistic" type and groups having strong unconscious homosexual organization. (*d*) In children, of an average age of two to three years, enjoying effective emotional contact with parents, no signs of traumatic shock were observed. Loss of parents or anxiety in parents resulted in anxiety or inhibition in the children.

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NEUROPATHOLOGY.

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THIS review is based on neuropathological contributions which have either a direct or indirect relation to mental disease or are of major general interest. Notwithstanding these restrictions the field which had to be covered remains vast, and no claim can be made that the survey of the literature is complete, although it is hoped that it is, to some extent, representative. In order to counteract this defect, recent reviews or comprehensive papers on special problems have been recommended, whenever they were available. They will enable the reader to trace references which for lack of space had to be suppressed. For the same reason of economy, a number of quotations have been made from reviews. This does not mean that the original papers have not been consulted.

GENERAL PROBLEMS AND TRENDS OF NEUROPATHOLOGY.

The apparent failure of neuropathology to supply pathological information in a large group of psychoses has emphasized the need for new avenues of approach, and in particular, for the improvement of existing methods and the introduction of new ones. During the period under review, attempts in various directions have been made, of which the following may serve as examples:

Examination in polarized light, already established as a method for some time past, has been employed by Weaver (1941) in studies of nerve fibres after artificially produced hyperpyrexia. The author regards this as the most sensitive and accurate technique available for studying early (reversible and irreversible) degeneration of myelinated nerve fibres.

There has been a marked revival of interest in terminals, which represent the anatomical substrate of synapses. Extensive anatomical work in this field had been done by Cajal, Bielschowsky and others, for the most part with a view to establishing or refuting the neurone theory. Recent work which has been reviewed by Bodian (1942) is more directed to pathological problems. Experimental changes occurring in end bulbs after axon sectioning, carried out in sympathetic ganglia and anterior horn cells of the spinal cord, have conclusively demonstrated the reality of synaptic knobs. Recently Glees and Le Gros Clark (quoted from Bodian, 1942) have clearly shown degeneration of end bulbs in the lateral geniculate body after lesions of the retinal endings of the optic nerve. Minkler (1942) has made studies in a variety of inflammatory

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and degenerative pathological conditions of the spinal cord. The technique has been considerably simplified by Bodian, Glees and Le Gros Clark and others, and Minkler even claimed successful results on material that had been in formalin for a long time. The difficulties of adequate assessment remain however, considerable, owing to the vagaries of fixation, silver staining and, particularly, the great number of boutons (which run easily into a thousand around a single anterior horn cell). Moreover, despite the quality of earlier work, little is known concerning the different forms of terminals, and, in particular, their variation in different parts of the brain. According to Glees (1942) there is a certain amount of evidence that it may be a general phenomenon of the central nervous system that terminals do not end freely, but have a definite end apparatus. Further work along these lines may well contribute new information in various directions.

Histochemical methods have been employed for the demonstration of various structures and substances. Staining of the erythrocytes by benzidine has become increasingly popular for the investigation of normal and abnormal vascularity, and disturbance of the blood circulation (*cf.* section on vascular disease). Pickworth, who first advocated the application of this method to the central nervous system, published in 1941 a modification, allowing a differential staining of red and white blood corpuscles.

To the demonstration of vitamin C in the nervous system by means of the silver nitrate method reference will be made later in this review. The distribution of alkaline phosphatase in the brain was studied by Landow, Kabat and Newman (1942), using Robison's histochemical test. They found greatest activity in the endothelial cells, in the brain stem of the chick, in various tumours, and also in plaques of disseminated sclerosis. Intravital staining has been particularly used for the elucidation of problems concerning the blood brain barrier. Friedemann, in a recent review (1942), has emphasized the importance of newly gained information about the electrical charge governing permeability to problems such as incubation period, neurotropy of micro-organisms, etc. Intravital staining has been advocated as an aid to neuro-surgery by Sorsby, Dickson-Wright and Elkeles (1943), who demonstrated that Kiton fast green, a basic dye with acid properties, stains connective tissue in mesodermal tumours, degenerating gliomas and cortical scars in epilepsy. This new approach may lead to further interesting developments.

Micro-incineration has been in use since Policard first devised a suitable technique in 1923. While its results, so far, have been limited in scope, systematic investigations, chiefly by Alexander (1938) and Alexander and Myerson (1938), have yielded undoubtedly valuable information about the neurone in normal and pathological conditions, and it is chiefly due to their labours that micro-incineration is becoming progressively more useful as a supplementary method in many neuropathological conditions. Heat-resistant ash is more marked in the cerebellum and allocortex than in the isocortex and basal ganglia, and there are significant differences in relation to architectonic boundaries. Immature nerve cells contain more ash than mature ones. The heaviest deposits have been found in the nucleolus and the Nissl substance of cytoplasm and dendrites, while the rest of the nucleus, neurofibrils, hillock, axis cylinder and myelin

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sheaths contain no ash or only a small amount. Many interesting observations have been made in a variety of pathological conditions. Hypermineralization has been found in haemorrhages, inflammation, tumour, tuberosclerosis, and in the neurofibrils of Alzheimer's disease; on the other hand, necrosis, softening, plaques of disseminated sclerosis, and the cell disease of amaurotic idiocy are characterized by loss of minerals. Alexander and Myerson (1938) also made an attempt at supplementing these results by spectroscopy, which with experience and careful manipulation yields reproducible results, although these are not always in accordance with those obtained from micro-incineration. Normal cerebral grey matter of the adult brain is richer than white matter in iron, calcium, magnesium and sodium, while white matter is richer in phosphorus. In the newborn most elements except iron are increased. In oedema there is an increase of sodium and calcium particularly within the white matter. No absolute increase of iron was found in dementia paralytica, despite heavy perivascular and intraglial deposits of this metal. This is explained by the concomitant decrease of the vascular bed in this condition. Lead, in lead encephalopathy, is mainly deposited in the grey matter. Meningiomas contain ten times as much calcium as normal grey matter, while spongioblastomas contain more potassium. Mention will be made of other results in later sections of this review.

Greenfield (1938), reviewing histochemical and cell physiological work on the neurone, came to the conclusion that so far little has been done to alter the conceptions formulated by Cajal and Nissl. Examination of the living and unfixed nerve cells had even established the real existence of cell constituents such as tigroid bodies and neurofibrils. In the meantime, however, there have been interesting general developments in the cytological field, as is shown in reviews by Gersh (1941), and particularly in the excellent book edited by Bourne (1942). New techniques of fixation have been developed, such as the Altman-Gersh method of freezing-drying which (since the application of liquid air stops all metabolic processes at once) has proved of immeasurable value for cytological studies. At the present time, however, its application to nervous tissue appears to be difficult.

The advent of fluorescence and electron microscopy is naturally of great interest. Fluorescence microscopy (Ellinger, 1940) has proved successful in investigations of certain pigments, vitamins and viruses. So far, little has been achieved in the nervous system, but it must be admitted that no appreciable systematic work has yet been done with fluorescent dyes in this field.

There are great and almost insuperable difficulties in regard to a direct application of electron microscopy to cytological studies, and especially to studies of nervous tissues. Its success, however, in virus diseases (Stanley and Anderson, 1941), other micro-organisms including the syphilitic spirochaetes (Mudd, Polevitzky and Anderson, 1942), and the reaction of micro-organisms to antibodies (Anderson and Stanley, 1941) is of indirect value to neuropathology, and, e.g., constitutes a challenge to workers in the field of neurosyphilis. Recently electron microscopy has been developed in combination with micro-incineration after fixation by the Altman-Gersh method (Scott and Packer, quoted from Bourne, 1942). This appears to open

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an almost unlimited field for studies of minerals in tissues, with a much greater accuracy of localization than was obtainable in ordinary histospectrographic analysis.

Bensley and Hoerr (quoted from Bourne, 1942) have devised a bold technique of dissecting out of liver cells, organelles, such as mitochondria, which have been subsequently submitted to various chemical investigations. New information is thus being collected about the composition and the normal and abnormal function of this and other cell constituents. In investigations of this kind much help will be derived from ultramicrochemical methods introduced by Linderström-Lang-Holter (quoted from Bourne, 1942), which are applicable to minute pieces of tissue and to microtome sections alternately used for chemical and histological examination. One of these methods, the Cartesian diver technique, enabled, for example, Boell and Nachmansohn (1940) and Nachmansohn and Steinbach (1942*a* and *b*) to estimate the content of cholinesterase, diphosphothiamine and succinic dehydrogenases separately in myelin sheaths and axoplasm in the giant fibre of the squid.

It has been said that the biochemist wants his material in test-tubes, whereas the histologist is merely interested in structure. However, the histologist's preoccupation with structure is a fairly recent development, and there are now unmistakable signs of a *rapprochement* between the two branches of science. This process is already extending to neuropathology, and will extend further in a measure, as new methods become applicable to the central nervous system. It will be closely watched by all workers in the psychiatric field.

Special Neuropathology: Inflammatory Diseases.

The problems concerning *syphilis* have been comprehensively reviewed by Reynolds, Mohr and Moore (1942). They mention two apparently spirochaetal conditions resembling syphilis which might be interesting subjects for comparative research: *Maladia del Pinta*, which may affect the central nervous system, and *Bejel*, occuring in the Euphrates Valley and producing predominantly bone lesions. With the help of the electron microscope, investigations have yielded some interesting new information about the structure of spirochaetes. Granular inclusions, lateral buds, and constrictions were clearly seen, and the organism was shown to be surrounded by a sheath which forms thin projecting tendrils. Further results, particularly in connection with the action of antibodies, may be confidently expected in the near future. Among other contributions to the spirochaetal problem may be mentioned that by Steiner (1940). Miliary necrosis in dementia paralytica and other syphilitic conditions is, according to him, due to spirochaetal conglomerations, forming reproduction centres in the living tissues of the host, and not the result of a vascular factor assumed to be operative by previous workers. The so-called silver cells described by the same author have been investigated by Blackman and Putnam (1938) and Hassin and Diamond (1939). The existence of granules was confirmed, but their spirochaetal origin denied. The last-mentioned authors doubted the cellular nature of the structures.

Several cases of stationary general paralysis have been investigated histo-

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logically (Galbraith, 1940; Urechia and Mueller, 1940; Pinto, 1941). The condition in Galbraith's case lasted 31 years. The pathogenesis of the Lissauer type of general paralysis has been under renewed discussion for some years, and the various views put forward have been reviewed in the light of a particularly early case by Galbraith and Meyer (1942), who found that the focal symptoms were produced by a local intensification of the inflammatory process rather than by an independent vascular factor or syncretic process. Morel and Duman (1941) made an attempt at assessing the relation between varieties of psychotic manifestations in general paralysis and changes in macroglia, microglia and oligodendroglia.

Studies have been made in Torula meningitis (de Busschaer, Scherer and Thomas, 1938), Rocky Mountain spotted fever (Hassin, 1940), pink disease (erythroedema polyneuritis) (Ratcliffe, 1941), and toxoplasmic encephalomyelitis (Cowen, Wolfe and Paige, 1942). This latter condition is of some interest, as its onset is congenital or soon after birth, and may result in various neurological and mental defects. Pathologically it is characterized by multiple foci of intracerebral calcification due to the tendency of the granulomas set up by the organism to calcify.

Boeck's disease (sarcoid), regarded by some as an unusual type of tuberculosis, was the subject of a study by Erickson, Odom and Stern (1942). The central nervous system was involved. The absence of necrosis in the granulomas produced would argue against tuberculosis and syphilis.

While fundamental discoveries about *neurotropic virus diseases* have been made in a period prior to that covered by this review, there have been none the less some noteworthy recent developments. A general review which includes also other neurological and psychological conditions in man and animals has been made by Findlay and Innes (1940), and the most recent developments have been discussed by Brain, Greenfield and Russell (1943). The new types of encephalomyelitis due to virus infection include Japanese B, St. Louis, Western and Eastern forms of equine encephalitis and Russian encephalitis. Equine encephalitis, which occurs also in man, has received the greatest attention (Adler, 1941; Baker and Noran, 1942; Weil and Breslich, 1942). According to the last-named authors all the various infections enumerated above have in common intense monocytic inflammation, with formation of dense foci of gliosis and diffuse astrocytosis. The inflammatory reaction is most marked in the grey masses of the mid-brain. The description given by the other authors differs, however, in some points from that given by Weil and Breslich.

While none of these virus infections has been observed in this country, Henson and Russell (1942), Russell (1943) and Greenfield (1943) reported cases of the type of encephalitis described by Hurst (1941) as "haemorrhagic leucoencephalitis." As the name suggests, it is characterized by polymorphonuclear exudate, perivascular necrosis, focal demyelination and microglial reaction confined almost exclusively to the white matter. The occurrence of polymorphonuclear leucocytes distinguishes this condition from post-vaccinial, post-influenzal, Baker's haemorrhagic encephalitis and purpura. According to Hurst, it forms a link between these last-mentioned inflammations and the demyelinizing diseases. It must also be distinguished from the encephalopathy

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occasionally following treatment by sulphanilamides (Fisher and Gilmour, 1939; Rosemann and Aring, 1941), which is interesting in view of the wide use of these drugs.

A rare type of encephalitis associated with the name of Dawson has been studied recently by various workers (Smith, Lennette and Reames, 1941; Akelaitis and Zeldis, 1942; Brain, Greenfield and Russell, 1943). It seems to occur predominantly in children; its course is subacute; involuntary movements are characteristic. The cerebro-spinal fluid is normal or contains only a few lymphocytes. In one case a virus identical with herpes simplex was isolated from the brain. The characteristic histological sign is the occurrence of eosinophil intranuclear inclusion bodies in the cortical neurones associated with perivascular exudation of lymphocytes and plasma cells, microglial reaction and astrocytosis. Inclusion bodies were also found in oligodendrogliocytes, but no demyelination ensued.

Bodian and Howe (1940) made a comprehensive experimental investigation on poliomyelitis. They concluded that nerve-cell pericarya are more important for the spread of the infection than fibre connections. The invasion was checked if the nerve cells were degenerated, e.g. in the thalamus. Kempf *et al.* (1941) were unable to infect rabbits by intracranial injections of poliomyelitis virus when the animals were kept in a condition of hypoglycaemia. The lowered susceptibility is possibly due to the decrease of cellular oxidation.

The significance of primary thrombosis in the pathogenesis of disseminated encephalomyelitis has been again stressed by Putnam and Alexander (1939). Apart from local infection as a pathogenic factor they consider the role of allergy, as had been done also by Finley (1938). The problem of anaphylaxis as cause for lesions in the brain has been the object of several experimental studies. Ferraro and Jervis (1940) and Jervis, Ferraro, Kopeloff and Kopeloff (1941) sensitized monkeys by sterile extract of rabbit brain and egg white respectively. The results were in accordance with previous experiences by other workers: scattered foci of demyelination and accumulation of fat-containing scavenger cells. There was also a local ("Arthus") phenomenon at the site of the intracerebral injections (necrosis, oedema, leucocytic infiltration). Kolb and Bolton (1940) were unable to produce demyelination in rats by injections of rabbit serum containing brain antibodies.

Intoxication.

Studies on intoxication, particularly if conducted on a comprehensive experimental and comparative scale, have obtained considerable importance as a means of investigating the reactions of the central nervous system to known agents. This is stressed by Ferraro, Jervis and English (1938), who, summarizing earlier work, point out the differential attack of various substances. Metallic salts, inorganic acids, histamine, etc., produce changes of nerve cells, cyanides affect the myelin, arsenic has a specific action on blood vessels, and guanidine appears to act upon the macroglia. In the same paper they report experimental results with phosphorus, which seems to act on nerve cells (vacuolation), on the blood vessels (focal cortical necrosis, haemorrhages and

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endothelial proliferation), and on the glia. In particular, a swelling of the microglia is described which is considered to be a counterpart to that of the oligodendroglia. Fatty degeneration, often regarded as specific of phosphorus poisoning, was absent in their animal material, as it was in the eight human cases investigated by Takeyo-Sikō (1939).

Encephalopathy produced by arsenicals, and especially arsphenamine, was the subject of several studies (Roseman and Aring, 1941; Ecker and Kernohan, 1941). Alterations in the nerve cells, perivascular necrosis due to endothelial damage of the small vessels and inflammatory reaction were the main features, while petechial haemorrhages were less important.

A study of deposits of gold in the central nervous system in animals after injection of gold salts (Roberts, 1939) is of some interest in view of its therapeutic use. The metal was found in nerve and glial cells in the nuclei of the intracranial nerves, supraoptic and infundibular nuclei, Purkinjë cells and anterior horn cells.

Scholz and Hsü (1938), following up earlier experimental work, investigated late damage from X-ray radiation of the human brain. Extensive foci of necrosis were found, due to severe degeneration of the blood vessels, the walls of which contained homogeneous hyalin-like deposits.

Of greater interest to the psychiatrist are experiments carried out by Schube and Raskin (1940) with benzedrine. It appears that after large doses congestion and stasis of meningeal and intracerebral vessels, including those of the choroid plexus, occur, leading to haemorrhages in the cerebellum and other parts of the brain. Only guinea-pigs and rats were used and no illustrations are given.

A number of contributions has been made in relation to so-called anoxic poisons, including carbon monoxide, cyanide, and carbon bisulphide, anaesthetics, and barbiturates. Their study is not only interesting because of the mental changes that often ensue, but also in view of their close liaison with problems of a general nature, such as selective regional vulnerability, demyelination, etc.

Carbon monoxide poisoning is the oldest and best known member of this group. Raskin and Mullaney (1940) have recently given a comprehensive review of its nervous, mental and histological sequelae, to which they added a new and thoroughly examined case which had survived the acute poisoning for 15 years. Hsü and Ch'Eng (1938) studied the "myelinopathy" in carbon monoxide poisoning, an already well-known lesion which they consider to be the direct effect of anoxaemia. An investigation into the pathogenesis of demyelination was also the aim of histological and biochemical experimental studies in cyanide poisoning by Hurst (1940, 1941) and Windham (1941). Their results indicated that anoxaemia is more important than the inhibition of cellular enzymes (succinic dehydrogenases, cytochrome oxidase and catalase). Sodium azide, though in its biochemical action resembling cyanide, has no histological effect. The histological lesions vary according to the degree of poisoning: in severe poisoning the cerebral and cerebellar cortex suffer most; in less severe intoxication lesions of the basal ganglia (putamen and globus pallidus) are predominant; in repeated slight poisoning there is, apart from the

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necrosis of the basal ganglia, demyelination of the white matter. While, in the opinion of the present writer, it is of great interest that demyelination of the white matter can be produced by carbon monoxide, cyanide and other poisons, there is no record of any case of true demyelinizing disease with selective lesions of the globus pallidus such as occur characteristically after poisoning. It may be added in this connection that according to Verhaert (1941) demyelinization may be produced in lead poisoning, while Jervis and Kindwall (1942) describe a case resembling Schilder's disease clinically and pathologically, following ergotamine poisoning.

The clinical and pathological sequelae of anaesthesia have been the subject of a number of papers during the period under review. Steegman (1939) described the pathological lesions in four fatalities. Abbot and Courville (1938), Batten and Courville (1940) and Winblad (1940) dealt with the ill-effects of nitrous oxide poisoning, while Courville (1941) paid attention to ether anaesthesia. Again, lesions localized in the cerebral and cerebellar cortex, globus pallidus, Sommer sector, etc., figure foremost in nitrous oxide poisoning, and they have been also previously described, after respiratory failure caused by prolonged ether anaesthesia (Meyer and Blume, 1934). Although lack of oxygen is recognized as the primary cause of the lesions in all these intoxications, there are differences in the pathogenesis, which in the opinion of Courville (1941) warrant the introduction of the concept of a " selective anoxia." Batten and Courville (1940) were particularly interested in the mental changes following nitrous oxide anaesthesia which they studied in 10 personal cases, reviewing also 11 cases described by earlier workers. Confusion, stupor, coma, and progressive dementia were the chief psychotic symptoms, while choreathetosis and rigidity indicated involvement of the basal ganglia. Ether tremor and ether convulsions, which have attracted considerable attention in recent years, are, according to Courville (1941), of anoxic origin, and not due to hyperpyrexia, acidosis, etc.

It is interesting that selective necrosis of the globus pallidus may occur after barbiturate poisoning (de Groat, 1940 ; Alexander, 1942*b*). In the cases of Alexander, softening of the cerebellar cortex and widespread thrombosis of veins in the cerebral white matter were additional features. Lesions of the lenticular nucleus and, in particular, of the globus pallidus have been described in carbon bisulphide poisoning by Alpers and Lewy (1940), Ferraro, Jervis and Flicker (1941). In addition, there are diffuse and circumscribed changes in other parts of the brain which are not yet fully understood. Carbon bisulphide poisoning deserves attention because of its industrial importance and the frequency of mental changes.

The vulnerability of the globus pallidus and other centres in this group of anoxic conditions (which incidentally comprise, in addition to the above-mentioned poisons, morphine, dinitrobenzol, ether, manganese and severe anaemia) has, in the past, aroused the interest of many workers, including the present writer. The latest attempt to solve the problem has been made by Alexander (1942*a* and *b*). On the strength of pathological investigations and a painstaking re-examination of the blood supply to the basal ganglia, this author concludes that the softening of the globus pallidus is due to thrombosis of the

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anterior choroid artery, which he suggests renaming the pallido-hippocampo-capsular artery, in accordance with the main regions supplied. This artery is prone to undergo thrombosis during circulatory disturbances because it has the longest subarachnoid course and the greatest "undivided length" of any cerebral vessel of similar calibre. Detail must be consulted in the original papers. The author, summarizing, states that "the two most vulnerable structures of the human brain, the globus pallidus and the cornu ammonis, are both supplied by the anterior choroid artery." Next to this artery, the long thin venules in the cerebral white matter are most susceptible to thrombosis.

It remains to be seen how generally Alexander's interesting claim will be accepted. Most previous workers who have agreed that peculiarities in the blood supply and oxygenation determine the susceptibility of the centres concerned have vigorously denied thrombosis as a primary cause. Moreover, while lesions in the globus pallidus and cornu ammonis occur frequently together in anoxic conditions, the absence of globus pallidus lesions in epilepsy would require an additional explanation. As at an earlier stage of the discussion, comparative experimental studies will prove useful for the solution of the problem. In this regard, an interesting contribution has been made by Scharrer (1940). He found that in the opossum the cornu ammonis is the chief site of lesions in carbon monoxide poisoning. The vessels in this region are arranged in a rake-like pattern which, according to the author, explains why the blood pressure can drop locally below a critical level before this condition occurs in the rest of the brain.

Vascular Disease and Disturbances of Circulation.

A useful general survey of recent work on gross vascular disease has been presented by Scupham, de Takats, van Dellen and Marcus (1942). It includes pathogenic, symptomatological, pathological and therapeutic aspects of arteriosclerosis, hyperpiesis, thromboangiitis obliterans, etc. Original contributions deal with periarteritis nodosa, which affects the brain in about 20 per cent. of cases (Malamud and Foster, 1942), lesions in the central nervous system associated with subacute bacterial, chronic verrucose and other types of endocarditis (Bruetsch, 1938, 1939; Kernohan, Woltman and Barnes, 1939), cerebral arteriosclerosis (Winkelman, 1939), malignant hypertension (Rosenberg, 1940), granular or verrucose atrophy in hyperpiesis and progressive vascular disease of the cerebral cortex on an arteriosclerotic basis (Greenfield, 1938).

Of special psychiatric interest is the increasing frequency with which the vascular changes characteristic of thrombo-angiitis obliterans are found in the brain, leading to various types of organic mental disorder (Meves [clinical report on four cases], 1938); Nils Antoni, 1941). Krücke (1940) described the formation of true bone during the organization of the thrombus in this disease.

Scholz and Nieto (1938) and Scholz (1938) made an anatomical and histochemical analysis of certain vascular affections which are often confused with arteriosclerosis. One of them ("*drusige*" degeneration) is related to the perivascular type of senile plaques and is only found in the highest age-group.

An attempt at correlation between mental symptoms in cerebral arterio-

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sclerosis and neuropathological changes was made by Rothschild (1942) on the strength of 28 cases. There were marked discrepancies between the degree of anatomical change and psychosis. In some cases no anatomical substrate was found at all. This discrepancy is explained by the differing capacity of the individual to compensate for brain damage. The same explanation had been given by this author in an earlier paper (1937) for the lack of correlation between senile anatomical changes and intellectual impairment.

The discussion on the pathology of apoplexy, which was very lively at an earlier period, has quietened down. K. Stern (1938), while accepting the importance of vasomotor factors, points out that no single theory is as yet wholly satisfactory. The preference for haemorrhages to occur in the area of the basilar artery (as found in hyperpiesia) may be due to oedema, or the rapid increase of intracranial pressure. This author advocates more work on the venous side of the circulation in order to understand the phenomena of the apoplectic insult. In parenthesis, Schlesinger (1939, 1940) has, in the course of his experimental work, investigated anatomical and pathological problems related to venous circulation in the brain, particularly the galenic system.

Interest in cerebral fat embolism has been considerable, partly in association with war and air raid injuries, partly in relation to occasional complications of convulsive treatment of psychoses (Nightingale and Meyer, 1940; Silverstein and Konzelman, 1940; Robb-Smith, Russell, Greenfield, 1941; Winkelman, 1942). No new points of major importance have been introduced. In this connection neuropathological investigations in sickle cell anaemia are of interest. Gross neurological symptoms are occasionally seen in this condition (Skoog, 1940). Wertham, Mitchell and Angrist (1942) found, in addition to small areas of softening and haemorrhages, intravascular lipoids which, however, did not give the reactions of neutral fat. They make the interesting suggestion that the lipoid material is derived from the disintegrating lipoid cell membrane of the red blood corpuscles, which for this reason assume the sickle form.

It is impossible to give even a superficial account of the results of studies made in relation to disturbance of the cerebral circulation. Many of the problems are of a physiological nature and will be dealt with elsewhere in this volume. It is now generally accepted that there are myelinated and unmyelinated fibres on cerebral vessels, and that their function is the maintenance of the intracranial blood-flow (Forbes and Cobb, 1938; Forbes, 1940). The benzidine stain has been increasingly employed to demonstrate normal and abnormal circulation (Putnam and Alexander, 1938; Alexander and Putnam, 1938; Campbell, Alexander and Putnam, 1938; Fazio, 1938; Sahs and Alexander, 1939; Hardman, 1940). It has been found useful in the diagnosis of stasis, thrombosis and embolism. Perivascular haemorrhages are shown to be netlike in the grey, and nodular in the white matter. Certain characteristics of the vascular arrangement in recent and old softenings, scars, Wernicke's disease, various tumours, etc., come out well. Size, density and regularity of the sinusoids have a definite relation to the differentiation of the tumours, which have in common inadequacy and awkwardness of the blood supply. In dementia paralytica and other organic psychoses a considerable

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loss of the vascular bed of the cerebral cortex is demonstrable, and this is borne out by investigations of the cerebral blood-flow, which in severe cases is reduced by about a third (Rosenbaum, Roseman, Aring, Ferris, 1942). An interesting study of the correlation between vascularity (as demonstrated by benzidine stain) and the oxidase reaction has been carried out in the cat brain by Campbell (1939). There exists a parallelism between the amount of the enzyme and vascularity. Both are low in the archicortex, while within the isocortex the highest values are found in laminae 3 and 4. Of the centres of the basal ganglia, the globus pallidus is lowest and the lateral geniculate body highest in the scale; the values in the cerebellum approach those found in the isocortex.

Many other investigations into the normal vascular bed of various centres of the brain cannot be discussed here.

Dreszer and Scholz (1939) made an interesting use of benzidine stains for investigations into the pathogenesis of cardiazol convulsions. They claimed that anaemia of the brain could be demonstrated preceding the onset of the convulsion. Whitehead *et al.* (1940) made a similar observation in one animal, but A. Meyer (1939), working with Watterson and M. Meyer, failed to confirm this result in a series of controlled experiments. Severe irregularities of the blood circulation were, however, seen in later stages of the convulsions, and also after injection of vasodilator drugs. This would be in accord with the clinical and physiological experiences of Penfield and other workers, for the detail of which the exhaustive monograph on epilepsy and cerebral localization by Penfield and Erickson (1941) should be consulted.

In sudden arrest of the circulation of the brain, Weinberger, Gibbon and Gibbon (1940) found permanent damage after interruption of 3′ 10″ (three minutes, ten seconds), necrosis and softening after 3′ 25″, and complete destruction and liquefaction after 7′ 30″. In order of susceptibility, visual and motor cortex rank first, while orbital, olfactory and temporal cortex are least vulnerable. Laminae 3 and 4 are most affected. Among other structures the order is: Purkinjë cells, lateral geniculate body, hypothalamic nuclei, thalamus, globus pallidus, caudate nucleus. The brain stem and spinal cord are usually uninjured. It is interesting to note that there is much agreement with Campbell's results above, and also, that the individual susceptibility after arrest of circulation does not correspond to that in anoxia, which seems to be quite a different mechanism. The presence of much inflammatory change is also an interesting phenomenon. Kabat and Schadewald (1941) found the susceptibility to arrest of circulation of synaptic terminals much lower than that of the nerve cells on which they end. They regard this as strong evidence against structural continuity.

In the period under review work has been done with regard to the chemical and histological clarification of cerebral oedema and brain swelling. Most of it has been reviewed by Greenfield (1942). According to him there are physical, chemical and histological criteria of oedema. He does not recognize an essential difference between oedema and swelling, which differ only by degree. As physical criterion he accepts the statement by Alexander and Looney (1938), who define oedema as an increase of brain size beyond 96 per cent. of skull capacity. Chemical criteria have been summarized by Stewart-

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Wallace (1939), who found increase of fluid and of Na and Cl ions in the white matter with the exception of the big commissural and associational fibre tracts. Cortex and basal ganglia do not participate. The excess fluid is probably derived from the blood. The histological criteria are best studied in oedema associated with malignant tumours (Greenfield, 1939). In myelin-stained slides the centrum ovale is pale, but the large commissural tracts are not affected. The reduced stainability is due to separation of the fibres, but after some time true degeneration ensues in severer cases. The axis cylinders are less affected, although there is frequently some swelling and beading. Clasmatodendrosis is one of the most constant signs, and not a chance finding as it was believed to be by earlier workers. In cases of longer standing this may pass over into a proliferative type of astrocyte. The oligodendroglia shows little change, and abnormalities of the microglia depend on the stage of myelin-degeneration. The changes in the white matter are ill defined, gradually merging with the normal tissue. There is much confusion about the naked-eye identification of oedema. Neither wetness of the surface nor congestion are characteristic. The only certain criterion in the fresh brain is diffuse yellowish discoloration of the white matter. The commonest cause of oedema is thrombosis of the cerebral vessels; next come cerebral tumours, granulomas and abscesses. In the experience of Greenfield trauma leads only rarely to generalized oedema, which is usually limited to the neighbourhood of the bruised area.

Senile and Presenile Conditions.

The problem of presenile dementias has been dealt with in a discussion at the Royal Society of Medicine in which Mayer-Gross, Critchley, Greenfield and A. Meyer took part (1938). More recently it has been the subject of a comprehensive review by McMenemy (1941). The tendency was to widen the conception of presenile dementia beyond what McMenemy calls the essential group, i.e. Alzheimer's disease and Pick's disease, which form only a small part of organic conditions presenting themselves at this age-period. This broader conception should be welcomed, as there are undoubtedly other presenile conditions which have not yet been fully explored. One of them, the Jakob-Creutzfeld syndrome, has aroused increasing interest, contributions having been made by A. Meyer (1938), Stadler (1939), Jansen and Monrad-Krohn (1939), Davison and Rabiner (1940), Jervis, Hurdum and O'Neill (1942). Worster-Drought, Greenfield and McMenemy (1940) and McMenemy and Pollack (1941) published further important cases of presenile psychosis, so far unclassifiable. K. Stern's (1939) case of thalamic degeneration associated with dementia (discussed later) belongs also to this group, as does the acute catatoniform psychosis described under the heading of Kraepelin's disease by Best (1941). In this process of exploring the presenile dementias on a wider scale, it would be a mistake, however, to include conditions such as the epilepsies, demyelinizing diseases and others whose incidence at this age-period is more or less fortuitous. It should also not be forgotten that the "essential dementias"—although only a small group—have a particularly close relation to the process of ageing, and they are, thus, the natural object of fundamental

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pathological studies in this field. They will be, therefore, the principal subject of this review.

In the period under review there have been published numerous new cases of Alzheimer's disease (Liebers, 1939; McMenemy, Worster-Drought, Flind and Williams, 1939; van Bogaert, Maere and Schmedt, 1940; McMenemy, 1940; Grünthal and Wenger, 1940; Ferraro and Jervis, 1941; Hemphill and Stengel, 1941; English, 1942), and of Pick's disease (Davison, 1938; Nichols and Weigner, 1938; Löwenberg, Boyd and Salon, 1939; Bouton, 1940; Bosch and Orlando, 1940; Malamud and Boyd, 1940; Hassin and Levitin, 1941). In the contributions on Alzheimer's disease particular attention has been paid to familial or hereditary aspects and to onset before the presenium (Grünthal and Wenger, van Bogaert, Maere and Schmedt, Ferraro and Jervis). Van Bogaert *et al.* divide cases into early, middle-aged and presenile, occurring either sporadically or in families. In the brain of one of the two familial cases investigated by Grünthal and Wenger neither plaques nor neurofibrillar changes were found; instead there was a circumscribed atrophy of the frontal lobes. The authors argue that plaques, etc., may not be an essential feature of Alzheimer's disease, but may possibly be due to a superimposed factor of hypovitaminosis. There is, however, at least the possibility that the authors had been dealing with the equally interesting familial concurrence of Alzheimer's and Pick's disease.

In the case of Hemphill and Stengel the interesting observation of hemiatrophy with crossed cerebellar degeneration was made.

There have not been any major advances in the pathology of Pick's disease, which Nichols and Weigner suggest renaming idiopathic circumscribed presenile cerebral atrophy. Attention has been focused on the interpretation of the clinical symptomatology in the light of the localization of the lesion. The frequent presence of a hereditary factor and of early manifestation of the disease has been stressed by Löwenberg, Boyd and Salon. These authors and also Malamud and Boyd confirm the earlier view that the condition is a system disease affecting—though not exclusively—the highest centres within the frontal, temporal and parietal lobes. Hassin and Levitin emphasize the discrepancy between mild parenchymatous and severe neuroglial proliferation. They favour a toxic etiology in view of the similarity to changes produced by metrazol. It is interesting that the gliosis of the white matter may be so intense as to cause hypermineralization (Alexander and Looney, 1938*b*).

The occurrence of argentophilic structures in these conditions has stimulated much further research into their pathogenesis and relation to the problem of ageing. A good historical survey has been given by McMenemy (1940). From this it appears that the theory associated with the names of Ruzicka, Grünthal and von Braunmühl has been, in principle at least, accepted by most workers. Accordingly ageing is essentially a change of the brain colloids from a highly dispersed to a less dispersed state, resulting in condensation and coagulation (hysteresis). This process is alleged to take place in the so-called ground substance. Plaques and the thickening of the neurofibrils are secondary phenomena. It is possible that dehydration is a related factor. Its importance in regard to the pathology of senility has been stressed by Alexander and Looney

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(1938*a*), who found the post-mortem water-binding capacity decreased in senile brains.

With regard to detail there have been, however, many divergencies of opinion. It has been said that von Braunmühl's colloidal experiments do not account for all forms of senile plaques (Müller, 1939; Jakob, 1939). The mechanism of the perivascular plaque, for example, is regarded as different, and explained by vessel wall changes described by Scholz as "*drusige Entartung*" (to which reference has been made in the paragraph on vascular diseases). King (1942), using impregnation with ammoniacal silver without further chemical treatment, also accepts the vascular change described by Scholz as responsible for perivascular plaques, and, in addition, found that in the Ammon's horn plaques may develop from degenerating neurofibrils. While he reserves this mechanism for one type of plaque only, Soniat (1941) regards it as operative in the great majority of plaques. Alexander and Looney (1938*b*), using micro-incineration, found hypermineralization at the site of argentophilic neurofibrils and other intracellular argentophil inclusions in senile dementia, Alzheimer's disease, Pick's disease, pellagral ganglion change and the change experimentally produced by soaking. They failed, however, to demonstrate either increase or decrease of ash at the site of plaques, which they regard as metaplasias of the glial reticulum, and not as a reticulum containing an excess of inorganic substances. This is, according to the authors, at variance with von Braunmühl's theory.

Müller (1939) found that the silver impregnability of plaques is reduced if unstained sections have been previously treated with acetone or xylol. He also failed to demonstrate argentophil structures in the brains of old animals. It is difficult to accept his explanation that this might be due to the shorter life period of animals as compared with that of man.

There remain, thus, many obscurities in the pathogenesis of plaques and related phenomena. As Soniat (1941) points out, our chemical methods are not yet adequate enough to elucidate the complex biochemical processes involved in the formation of plaques. One point, however, seems to emerge clearly, that is, that glial cells are not primarily concerned with plaque formation (McMenemy, 1940; Soniat, 1941; King, 1942). The proliferation of microglia and astrocytes is a reaction to the formation of the plaque, and the oligodendroglia is apparently involved for spatial reasons only. The reaction of the various glial cells, however, seems to account for certain morphological variations in the final appearance of the plaque (McMenemy, 1940).

According to Korenchevsky (1942), ageing is associated with hypoplasia of all organs which commences soon after birth. The prime of life is, thus, in early infancy. In addition there is a fall in the nucleocytoplasmic ratio parallel with increasing age. There are also reports of a progressive reduction of anterior horn cells and spinal roots (Gardner, 1940), of olfactory nerves (Smith, 1942), of *bouton terminaux* in the spinal cord (Minckler, 1942), of increase of lipoids in afferent neurones (Truex and Zwemer, 1942), and increased neuronophagia (Andrew, 1939, 1940). It is obvious that these localized findings are only of limited value. They must be considered in relation to other anatomico-pathologic, biochemical and endocrinological aspects.

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Head Injuries.

The war has, naturally, stimulated much work on injuries of the central nervous system. From the pathological point of view the problem of concussion and the pathogenesis of blast injuries have received particular attention, and it is proposed to confine this review to the developments made in these conditions.

As regards concussion, Greenfield (1938) has given a survey of different pathogenic theories, both historical and current. According to him these theories may be divided into vascular, humoral and mechanical. The vascular theory most popular in this country is Trotter's modification of Kocher's theory, which attributes loss of consciousness to sudden anaemia. The classical example of humoral theories is that of Duret, supported by Berner, which presupposes a wave of cerebrospinal fluid being driven from the lateral ventricles towards the foramen magnum, distending on its way the third and fourth ventricles and Sylvian aqueduct. The theories of a direct mechanical effect on the nervous tissue may be conveniently subdivided into three: compression, vibration, and deformation and stretching.

The investigations made within the period covered by this review differ in their support to the main theories just outlined. Among those who favour a vascular pathogenesis are Schaller, Tamaki and Newman (1941). These authors submitted rats to a propulsion impact to the head by dropping them from variable heights. Diapedetic petechiae, thrombosis and hyalin change of the blood vessels were produced, which they regard as identical with those observed in human brains after concussion, and which they strictly separate from the changes seen in contusion, laceration and tearing. They are, according to the authors, the result of vascular dilatation, stasis and anoxaemia. Some of the changes, through resorption of petechiae, are reversible, and there is also a tendency to reparation by final obliteration of the damaged vessels with ensuing replacement gliosis. No large haemorrhages nor softenings were seen, nor was there a tendency to progression.

Vasomotor changes operating as outlined by Ricker are held by Helfand (1939) to be responsible for most of the changes seen in the brains of 22 cases of head injuries. Mechanical factors, e.g., resulting in displacement of Purkinjë cells, play only a minor part. In a later paper Helfand (1941), using the Pickworth method, demonstrates local disturbances in the vascular pattern.

Dixon (1940) suggests an explanation somewhat along the lines of Trotter's, with the difference that it is not the blood driven out of the brain vessels, but the cerebrospinal fluid drawn out of perivascular and perineuronal spaces, thus depriving the neurones suddenly of their nutrition, and in particular of the sugar which is essential for their normal action.

There is no doubt that the great majority of contributors to the problem of concussion adhere to a mechanical pathogenesis in one or other manner. Greenfield (1938) thinks that the theory of deformation and stretching, already accepted for spinal concussion, fits also best with the known facts of cerebral concussion. The alterations in the shape of the brain which result from a blow on the head produce sudden stretching of nerve fibres and other tissues, especially blood vessels, at various places in the brain, especially where the impact is

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resisted by dural septa or bony ridges. The tearing of the vessels need not result in rupture, but may well damage the endothelial lining and the local contractile mechanism by which the arterioles react to changes in internal pressure. This seems to the author a more satisfactory way of accounting for dilatation of vessels than Ricker's theory of traumatic paralysis of vasomotor nerves. A local dilatation of small vessels may also account for oedema, but Greenfield (1938, 1942) makes the important point that general oedema is rare in head injuries. It may occur locally beneath an area of bruising, and is then often followed by severe local demyelination and gliosis. The area around the anterior horns of the lateral ventricle is a favourite site for this lesion, in which the humoral mechanism as outlined by Duret and Berner may have at least a partial significance. The sudden loss of consciousness in concussion may possibly result from tearing of fibres in thalamic and hypothalamic centres. It cannot be explained by the small haemorrhages frequently found in the grey matter around the Sylvian aqueduct, and more deeply in the tegmentum. These are seen, in connection with other haemorrhages, in severe cases of head injury and are not pathognomonic of concussion.

The important experimental investigations by Denny-Brown and Ritchie Russell (1941) also support a mechanical explanation of concussion. The only limitation of the value of their work, as stated by the authors themselves, lies in the fact that states of unconsciousness cannot easily be studied in animals (cats, dogs, and monkeys were used), particularly in animals under anaesthetic. The main points arrived at are, that concussion of short duration can occur without histological changes in the brain. There was no evidence of vascular spasm or stasis in the brain. If, in severer types of head injury, haemorrhages (petechial, or large ones) are produced, they are due to distortion and tearing of blood vessels, and not to a paralysis of vasomotor nerves as suggested by Ricker. The phenomena of concussion are produced by a general physical injury of great complexity to the neurones, which causes reflex paralysis of respiratory and vasomotor mechanism *via* centres in the medulla and pons. This effect is produced when the forebrain is absent (after decerebration), and when vestibular influences are excluded (after cutting the eighth nerve). It is necessary to distinguish between "acceleration concussion," which occurs when the skull is subjected to a sudden change of velocity, and which is associated with only a negligible rise of intracranial pressure, and "compression concussion," produced by a blow on the head supported on a hard surface. In this latter type the rise of pressure is considerable, but must be about ten times the normal in order to be effective in the animals used.

Scott (1940) observed in dogs whose heads were held in a specially designed apparatus while a mechanical force was applied, increase of intracranial pressure. He was obviously dealing with "compression concussion." No histological changes were demonstrable.

Williams and Denny-Brown (1941) found in experimental concussion always instantaneous generalized reduction of cerebral electrical activity, which they interpret as a direct result of mechanical violence to cerebral cells, and not of secondary changes such as oedema, anoxia or hypoglycaemia.

Views expressed by Dawson (1939), Hassin (1940), and de Gutierrez-Mahoney

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(1941), are, as a whole, in keeping with a theory of direct action on the neurones in concussion. Hassin bases his opinion on his observation of tearing of large vessels in electrocution. Hassin, as well as Scheinker (1940) and Courville (1942), however, differ from the views of Greenfield on traumatic oedema, to which they attribute much importance. Gutierrez-Mahoney also stressed the occurrence of fat embolism in brain vessels, which he regards as being derived from shattered myelin. The shortness of time in his human cases required to break down the myelin lipoids to neutral fat is, however, surprising.

The important problem of *blast injuries* has been the subject of several discussions and papers (Zuckerman, 1941; Stewart, Russell and Cone, 1941; Krohn, Whitteridge and Zuckerman, 1942). The conclusions are based predominantly on experimental investigations in animals of various species (mice, rats, guinea-pigs, rabbits, cats, monkeys, and pigeons). Stewart and his associates were able to study the effects of blast in a pheasant injured during an air raid. The most important effect of the blast waves is directed against the body wall, resulting in haemorrhage of internal organs, foremost in the lungs. If the trunk is protected no changes in the internal organs are found, indicating that there is no pressure or suction through nose or mouth. In the nervous system haemorrhages around thoracic spinal roots are constant, but meningeal, ventricular and intracerebral haemorrhages are rare, and occur only on exposure to highest pressures. Zuckerman (1941) reports that detailed investigation of the brains of his experimental animals by Greenfield and Le Gros Clark failed to demonstrate significant changes; these results were confirmed by Hadfield, speaking in the discussion. Changes in the brain if they occur are not regarded as due to a direct concussion-like effect, but are probably secondary to fall of blood pressure following changes in pulmonary blood-flow (Krohn, Whitteridge and Zuckerman, 1942), or violent venous back-pressure resulting from the sudden compression of the thoracic cage (Stewart and associates, 1941). It is worth mentioning that the electro-encephalogram demonstrates either no changes, or those characteristic of secondary anoxemia. Fat embolism is not an integral factor in the pathogenesis of blast injuries (as was contended), but, if found, it is a complication, as are also occasionally the sequelae of asphyxia, carbon-monoxide poisoning, burns, and drowning.

Deficiency Diseases.

Valuable reviews are available on the whole problem of nutritional deficiency (Butt, Leary and Wilder, 1942), vitamin B deficiency and nervous diseases (Aring and Spies, 1939), tissue changes in vitamin deficiency (Wolbach and Bessey, 1942), pathologic anatomy in avitaminosis (Hsü, 1942), pathologic effects produced by deficiency of single metallic and non-metallic elements (Follis, 1942). They should be consulted by all who want complete information about the numerous data concerning the pathology of nutrition. In this review it is not possible to give more than a rough outline of the principal and most striking advances.

It has now been established that nervous lesions produced by *vitamin A* deficiency are wholly of mechanical origin through disproportionate growth

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of the central nervous system in relation to surrounding bone (Wolbach and Bessey, 1941). This appears to solve previous controversies regarding experimental production of nervous lesions in A-avitaminosis. There is indeed very little of the vitamin in the normal central nervous system, as has been recently shown by Popper (1941) and Ragins and Popper (1942), who made a comparative study by means of fluorescence microscopy. Likewise deficiency of *vitamin D* is of very little importance to the central nervous system. Damage had been reported after repeated administration of massive doses, but Vollmer (1941) was unable to confirm this.

Vitamin C has been the subject of histochemical investigations by Wolf-Heidegger (1942), who used Giroud-Leblond's silver nitrate injection method. In normal animals silver deposits are found in the cytoplasm of nerve cells, microgliocytes, oligodendrocytes, and the epithelial cells of the choroid plexus, while none were seen in the ependymal cells. No reduction of the silver salt took place in the brains of vitamin C deficient animals. The apparent spatial relationship of the silver granules to the Golgi apparatus and the mitochondria is of great histochemical interest (Wolf-Heidegger, 1942; Bourne, 1942).

The chief neuropathological advance has been made in the field of ***vitamin B deficiencies***, and among these the most striking is that which led to the clarification of the Wernicke syndrome. Although in Wernicke's first case the lesion followed pyloric stenosis from sulphuric acid poisoning, subsequent opinion was that it was more or less specific of chronic alcoholism. It is Neubuerger's (1937) merit to have first drawn attention to its wider occurrence. Campbell and Biggart (1939) stressed the nutritional aspect as a common link, and even suggested vitamin B_1. The aetiology was finally clinched by the experimental work of Alexander (1939, 1940), who was able to produce lesions comparable to the Wernicke syndrome in pigeons fed on thiamine-free diet rich in other food-stuffs and containing A, the remaining Bs, C and D in excess. Alexander's results were in accordance with earlier work of Prickett (1934) and Zimmerman (1939–40, 1940), who both confirmed retrospectively his findings.

Apart from these main steps in the elucidation of its pathogenesis, there has been a vast literature on various pathological aspects of the Wernicke syndrome. It is now recognized that it may occur in the course of chronic gastric conditions, cholecystectomy with persistent vomiting, hyperemesis gravidarum (Sheehan and Sinclair, 1939), chronic febrile disease (Chang, Suh and Ling, 1941), depression associated with anorexia, pernicious anaemia, etc. Vonderahe (1939), describing haemorrhages around the third and fourth ventricle in 14 cases of peptic ulcer, may have been dealing, at least in some instances, with the Wernicke syndrome. He points out that certain signs of visceral and emotional irritability commonly associated with peptic ulcer may be of central origin. Moodiness, emotional lability, etc., have been clinically recognized as symptoms of slight thiamine deficiency. Chastek paralysis in foxes fed with a fish diet is an interesting counterpart of Wernicke's syndrome and likewise due to a deficiency in thiamine (Alexander, Green, Evans and Wolf, 1941; Evans, Carlson and Green, 1942). Ferraro and Roizin (1941) described similar changes in cats which had been starved.

Alexander (1940) is of the opinion that thiamine has an anti-angiodegenera-

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tive action, but he failed to explain why the lack of this factor should produce angiodegeneration in selected areas of the brain only. More recently Swank and Prados (1942) and Prados and Swank (1942) regarded the vascular changes in the Wernicke syndrome as secondary to an affection of the neurones. Faulty metabolites in the neurones due to the deficiency of thiamine produce vasodilation, haemorrhage, interstitial proliferation and sclerosis.

The neurohistology of pellagra, which is mainly, but not entirely identical with nicotinic acid deficiency (as, in a similar way, beri-beri is not wholly identical with thiamine deficiency [Leblond and Chaulin-Servinière, 1942]) has been competently reviewed by Hsü (1942). Of the triad, hyaline change of capillaries, diffuse fatty changes and primary irritation of large nerve cells, the latter seems to be the most constant histological symptom. Sclerosis of the posterior and lateral tracts is frequent. It is, however, more in the nature of a Wallerian degeneration than of the patchy honeycombed appearance in subacute combined degeneration. Aring, Bean, Roseman, Rosenbaum and Spies (1941), counting the fibres in peripheral nerves in pellagrins, found a reduction in 8 out of 10 cases.

Aring, Ryder, Roseman, Rosenbaum and Ferris (1941), and Loman, Rinkel and Myerson (1941), demonstrated after intravenous injection of nicotinic acid increase of blood-flow which seems to be more marked in the periphery than inside the cranium. This vasodilator effect is not shown by nicotinamide, which has the same therapeutic usefulness.

Although the biochemical aspects of Wernicke disease and pellagra are outside the scope of this review, they may be of great importance for the understanding of the pathogenesis of the structural changes. Since thiamine is necessary for complete combustion of carbohydrates, Wortis, Bueding, Stein and Jolliffe (1942) and Wortis, Bueding and Jolliffe (1942) studied pyruvic acid in Wernicke disease and peripheral neuropathy respectively. They found hyperpyruvaemia in patients suffering from Wernicke disease and acute peripheral neuropathy. Himwich, Spies, Fazekas and Nesin (1940), by studying the difference in arterial and venous circulation, found a decrease in metabolism of the brain in pellagrins and more marked still in beri-beri.

A few remarks are necessary about the remaining components of the B group and other vitamins which appear to be of little importance to human neuropathology. There is much controversy about the involvement of the central nervous system in riboflavin deficiency. Phillips and Engel (1938) described myelin degeneration, fragmentation of axis cylinders, degeneration of neuromuscular endplates and proliferation of Schwann cells in peripheral nerves, and gliosis and chromatolysis in the spinal cord of chicks fed on a diet low in riboflavin. They concluded that riboflavin is necessary for the growing chick, and might be specifically associated with myelin metabolism. Zimmerman (1939–40) considers the spinal cord lesions in pellagra to be due to riboflavin deficiency, quoting work by Sebrell and Onstott, and also unpublished work by Street, Cowgill and Zimmerman as proof. Sinclair (1943) refers to peripheral neuropathies observed during the siege of Madrid, and in particular to retrobulbar neuritis, in which deficiency of riboflavin appears to be the most likely cause. On the other hand, Lightner and Forbus (1940) were not able

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to produce any change in the central and peripheral nervous system, and Wolbach and Bessey (1942), although their work was not specifically concerned with the central nervous system, did not find any changes which could be regarded as other than the effect of starvation. They confirm, however, the important observation that riboflavin deficiency in various species of animals and possibly in man may lead to sudden collapse, associated with ataxia, inability to stand, loss of deep reflexes, coma, failing respiration and death. In the absence of any morphological pathology they postulate a chemical disturbance resulting in cellular asphyxia.

There is also some controversy with regard to the neuropathology of vitamin B_6 complex (pyridoxine) deficiency. Street, Cowgill and Zimmerman (1941) reported some degenerative changes in myelin sheaths of peripheral nerves and spinal cords of dogs, but at least the peripheral changes were to some extent found also in control animals. Antopol and Unna (1942) observed in rats the typical hyperkeratosis and acanthosis of ears, paws, and snouts, and a failure of spermatogenesis, without mentioning the nervous system, whilst Lightner and Forbus (1940) failed to discover any changes in the peripheral and central nervous system.

Vitamin E (*α-tocopherol*) deficiency produces in young chicks an apparently ischaemic neuromalacia of the cerebellum and occasionally the cerebrum (Adamstone, 1941). Monnier (1941) reported in adult rats after prolonged deficiency degeneration of the dorsal tracts of the spinal cord, sclerosis of anterior horn cells and vegetative lateral horn cells. There was also slight demyelination of spinal roots and nerves, including their end apparatus in the muscles. The muscle itself was degenerated. The author believes that the clinical amyotrophy is essentially myogenic, but may include a neurogenic component. The most recent experimental investigations by Pappenheimer (1942) and Wolf and Pappenheimer (1942) demonstrate that the central nervous system is unaffected and that the "amyotrophy" is not a progressive condition, but is due to a muscular degeneration of the Zenker type. That this is probably not far from the truth is borne out by the failure to influence amyotrophic disease in man by α-tocopherol therapy.

There have been no reports on pathological changes in the nervous system in deficiency of vitamin K and pantothenic acid. As regards biotin (vitamin H), Shaw and Phillips (1942) failed to produce in rats changes of the nervous system despite the fact that the animals died in a condition of extreme spasticity. This is in contrast to earlier findings (Findlay and Stern, quoted by the authors) of diffuse infiltration with small round cells and definite myelin changes in peripheral nerves. Biotin deficiency leads to involution of thymus and atrophy of testicles, and may have, thus, some relation to the process of ageing.

Although the neuropathology of *chronic alcoholism* has been to a very large extent merged with that of thiamine and nicotinic acid deficiency, many of the workers have stressed the great complexity of the pathogenesis of the nervous lesions. Jolliffe and Wortis (1941), Jolliffe, Wortis and Fein (1941) deal with various clinicopathological aspects of the Wernicke syndrome. Their main point among many others, which cannot be discussed in detail, is that the

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clinical symptomatology is due to multiple deficiencies, and not only to that of thiamine. Alexander (1941) has made an attempt at correlating the various neuropathological lesions with the pathogenic factors operative in chronic alcoholism. According to him the shrinkage of the brain may be due to atrophy or dehydration. Subdural haemorrhage may be caused by deficiency of vitamin C, the blood level of which has been found lowered. As regards the microscopic findings, he attributes the vascular Wernicke lesion to deficiency of thiamine, while the affection of the neurones (neuronitis) may be due to a deficiency of thiamine (as in peripheral nerves), or nicotinic acid (as in central nerve cells), or of the anti-anaemic factor (as in the long tracts). The same author (1942) found associated with the alcoholic cirrhosis of the liver changes in the putamen which he claims to be similar to those seen in hepato-lenticular degeneration. This combination suggests to him a possible avitaminotic basis of the latter condition.

Jamaica ginger (triorthocresyl phosphate), which may occasionally give rise to neuritis and spinal cord symptoms, produces different histological lesions, consisting chiefly of hyperplastic fibrosis of arterioles and capillaries (Aring, 1942).

In view of the emphasis laid on the Wernicke syndrome as the basis for the clinical symptomatology, it is also worth mentioning that Morel (1939) described in four cases of chronic alcoholism a laminar astrocytosis in the third layer of the cerebral cortex, using a silver impregnation method. None of these cases had a Wernicke lesion, but this was present in a case which was the subject of a later communication (Morel and Duman, 1940), and in which there was found, in addition, a diffuse granular degeneration of nerve cells of the prefrontal and frontal areas.

The complex problem of *demyelinizing disease* has been approached from various angles, and some of them (such as the inflammatory, allergic, toxic and vascular approach) have been mentioned in other sections of this review. Naturally, the possibility of a nutritional deficiency has been frequently discussed, although none of the known vitamins have so far been found deficient. There are, however, a few notable exceptions. One that has been known for a long time is subacute combined degeneration in pernicious anaemia, due to the absence of the anti-anaemic principle. It is not yet settled whether a similar condition in captive monkeys has the same aetiology (Hamerton, 1942). Swayback, a congenital disease of lambs with certain affinities to Schilder's disease, has been found to be due to lack of copper in the feed of the mother animal. It can be prevented in the offspring by giving copper to the pregnant animal (Innes, 1939). While it is not permissible to identify swayback with the demyelinating diseases of man, it is interesting to note that recently Winkelman and Moore (1942) have described a human equivalent to swayback. Mitchell (1941), who experimented with pigs under various avitaminotic conditions, found in both the avitaminotic and control animals a demyelination of the posterior tracts which appeared to be the result of the lack of an essential inorganic micro-constituent of the diet, probably copper.

A nutritional deficiency has been recently suggested for Marchiafava's disease which is characterized by demyelination of the corpus callosum and

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occasionally of some other large fibre tracts. Both Lolli (1941) and Bohrod (1942) regard thiamine deficiency as cause of the condition, which is, thus, a counterpart of the Wernicke syndrome. This suggestion is based on the fact that it occurs almost exclusively in alcoholics belonging to the poorer classes of the population. All the 50 cases so far reported were of Italian extraction. However, Bohrod (1942) quotes an earlier paper of Jervis, who produced a lesion of the corpus callosum by poisoning cats with cyanide of potassium (*cf.* also the investigations by Hurst and associates, discussed in the section on intoxication).

It would be beyond the scope of this survey to include many other papers dealing with various aspects of demyelinizing disease ; the whole problem has been comprehensively reviewed by Einarson and Neel (1938).

Lesions of the Hypothalamus and Thalamus in Relation to Mental Disease. Neuropathology of So-called Functional Psychoses.

There has been a wealth of evidence, and much of it convincing, that the hypothalamus controls vital bodily functions, such as cardiovascular regulation, body temperature, sleep, gastro-intestinal function, metabolism of water, carbohydrates and fat, pituitary function, etc. Those interested in these aspects will find all the necessary information in two excellent books on the hypothalamus (1938 and 1940), and in shorter reviews (Ingram, 1939 ; Kuntz, 1942).

These great advances have, naturally, aroused hopes that something might be gained from investigations in this part of the brain towards the solution of normal and disturbed psychological function, and, in particular, of those psychoses whose pathology is not yet known. While there is little doubt about a connection of the hypothalamus with vital psychological processes and the make-up of personality, the earlier and too sanguine expectations have not been fulfilled, and a distinct note of caution in regard to the speculative character of many current concepts has been sounded in recent papers reviewing the situation (Grinker, 1939 ; Alpers, 1940 ; Masserman, 1942). Indeed, as far as the anatomical aspect is concerned, only a few clear-cut facts have emerged so far.

One of the best known is the very constant association, in the Wernicke syndrome, of confusional states and the Korsakoff syndrome with an affection of the mamillary bodies and of the neighbouring grey matter around the third ventricle. Much thought has been given to explaining the anatomical and psychological mechanisms. Grünthal (1939) has drawn attention to the connection of the mamillary body with the dorsal agranular frontal cortex, *via* the anterior nucleus of the thalamus, and in accord with earlier theories of his own and of others, is inclined to regard the Korsakoff syndrome as the result of a general reduction of activity and tension.

A number of cases have been reported in which tumours or other lesions of the hypothalamus have given rise to hallucinatory disturbances, mostly of a visual type, memory defects, personality disorder, and particularly, manic excitement. Grinker (1939) and Alpers (1940), in their reviews, stress the

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frequency of manic syndromes. Stern and Dancey (1942) add their observation of mania associated with a glioma of the diencephalon. Like previous workers they were not able to give a more precise localization within the hypothalamus. Change of personality and sudden episodes of temper, and violence in the later stages of the illness, were described by Collins (1942), in a case in which the hypothalamus was also found destroyed by a tumour. The relationship of these reported psychological abnormalities to those encountered in patients with the Wernicke syndrome requires further elucidation.

Investigations of the hypothalamus have been also made in uncomplicated cases of so-called functional psychoses and in mental defectives. Larson (1939) found in all of his 14 cases of manic-depressive psychosis petechial haemorrhages in the midbrain and hypothalamus. It is hardly conceivable that these recent haemorrhages, which might occur as an agonal phenomenon, could have been primarily associated with the psychosis. Morgan (1939, 1940) found a notable reduction of the number of cells in various nuclei of the hypothalamus in the major psychoses, epilepsy and mental deficiency. Chromatolysis in the remaining cells indicates a chronic process, chromatolysis without cell loss signifies an early process, while absence of the cell change with marked reduction in number is typical of an end stage. The part most consistently involved is the substantia grisea and nucleus tuberis lateralis. Masserman (1942) rejects these results on "various technical and observational grounds," and it is indeed difficult to understand why conditions of such widely differing symptomatology should have almost the same anatomical substrate.

It may be mentioned that no variations in the secretory phenomena of hypothalamic cells have been observed in relation to any type of mental disorder (Scharrer and Scharrer, 1940).

The thalamus has figured in investigations designed to demonstrate secondary degeneration of those of its nuclei which receive fibres from diseased cortical areas. The purpose of these important studies is primarily anatomical to gain information in the human brain about the cortico-thalamic connections, which so far have been mainly established by experimental work. Le Gros Clark and Russell (1940) were able to demonstrate in a case of total cortical atrophy that all thalamic nuclei had degenerated with the exception of the centre median nucleus, whose function remains, thus, obscure. Stern (1941–42) examined the thalamus in a case of frontal lesion. He found that the medial part of the ventrolateral nucleus was degenerated, although the cortical area 4 was intact. Cases dying some time after leucotomy from intercurrent disease will be valuable for studies of this kind, but so far no such investigations have been published.

The important observation has been recently made by Alexander (1942), viz., that the myelo-architectural pattern of the normal thalamus shows a surprising number of individual differences. According to him, "one is led to the conclusion that human thalami are almost as different in appearance as human faces." So far he has not been able to correlate this variability with any peculiarity of behaviour, such as motor and emotional patterns, awkwardness and other normal variations.

A Korsakoff syndrome, rapidly developing into dementia, has been attributed

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by Stern (1939) to a presenile bilateral degeneration of the thalamus. The ventral, arcuate, midline nuclei and also both the lateral and medial geniculate bodies were preserved. The intellectual degeneration is explained by the repercussion of the thalamic degeneration upon the function of the cerebral cortex with which the thalamus is intimately connected. The cerebral cortex as well as the white matter were, however, not free from changes such as fatty degeneration of nerve cells and astrocytic gliosis, but they were not regarded as sufficient to explain the severe mental symptoms. The author refers to his and Smith's earlier experiences with thalamic tumours, which were often found to be associated with dementia. The case is so far unique in the literature; in cases of thalamic hypertrophy published by Nevin (1938) there were widespread additional blastomatous changes in other parts of the brain which could account for the mental symptoms.

In conclusion, a few remarks are necessary about the slender structural changes which have been often described in the brains of schizophrenics and other functional psychoses. They are now almost universally disregarded as a substrate of the psychosis (Peters, 1938*a* and *b*; Scheidegger, 1942). The occasional extensive vascular lesions found in the brains of patients dying suddenly are not directly associated with schizophrenia, but are the result of a vasomotor lability (Malamud and Boyd, 1939). In this connection, whether the pathological structure of cutaneous capillaries described by Olkon (1939) has any significance remains to be seen.

A very original and in its results startling approach to the anatomical problem of schizophrenia, manic-depressive psychosis and other mental disorder has been made by Elvidge and Reed (1938). They found swelling of the oligodendroglia in biopsy material taken from the brains of mental patients. It was found in the white matter. No such change was seen in biopsies of cases without mental change, as was also confirmed in the discussion by Penfield, who drew attention to the fact that the oligodendrogliocytes are the most frequent cells in the brain, and that they contain gliosomes which may indicate secretional properties. So far, apparently, no re-examination has been made. Campoma's (1939) paper on the same subject was not available for this review. It is difficult to understand that a somewhat labile phenomenon such as swelling of the oligodendroglia should be a permanent symptom in chronic psychoses without ever giving rise to more severe pathological changes. It is interesting that the authors were able to confirm their findings in the same patient at different intervals.

It is beyond the scope of this review to discuss the endocrinological, physiological and biochemical aspects of this group of psychoses.

The Neuropathology of Shock Treatment.

The flood of publications, both experimental and pathological, which started soon after the introduction of shock treatment has not yet abated during the period under review, although there has been a notable shift of interest towards the effects of convulsive therapy, particularly electrically induced convulsions, whereas hypoglycaemia had its peak period earlier.

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The most recent review on the neuropathology of *hypoglycaemia* has been given by Lawrence, Meyer and Nevin (1942), who after giving a historical survey on previous work, describe the pathology in six personal cases. Their review shows that gross vascular lesions (haemorrhages and softenings) are relatively rare. The main type of lesion is a widespread, often continuous necrosis, the nerve cells showing ischaemic or more often homogenizing or severe cell change. The cerebral cortex and the striatum (caudate nucleus and putamen) are most frequently affected, the cerebellum less so, whilst lesions in the remaining centres are usually slight. The cortical necrosis is often of the pseudo-laminar type, affecting especially the upper layers. In a small number of cases a gliosis of the cerebral and cerebellar white matter is the main lesion. It is impossible to give here a full account of the various pathogenic theories which have been put forward in the course of time; the review shows that the majority of workers adopting Ricker's and Spielmeyer's suggestions have considered vasomotor disturbances as the cause of the lesions. In addition, the importance of a chemical factor is increasingly realized. Lack of the substrate glucose results in non-utilization of oxygen. Although the effect on the nervous parenchyma is more or less identical with that of anoxia, it is hardly correct to describe the hypoglycaemic mechanism by this term, since the oxygen concentration of the arterial blood is not decreased. The term oxyachrestia (cf. achrestic anaemia, from χρῆσις = use) is therefore suggested as useful and accurate.

The lesions described above are seen in fatal cases in which the coma has become irreversible. There has been much interest in the factors, both clinical and histological, which determine the irreversibility of the coma. Nerve-cell changes, most of them of a reversible nature, and some neuroglial and microglial proliferation, have been seen after therapeutic doses (Schmid, 1936), while Neumann, Cohn and Katzenelbogen (1942), under similar conditions, did not see any changes which could not be found in control animals. Winkelman and Moore (1940), who found severe cell damage, expressly stated that their cats died in secondary coma. According to Tyler and Ziskind (1940), the degree of brain damage is parallel to the dose of insulin. Cats must be kept for at least 100 minutes in a "medullary stage" of decerebration for irreparable damage to be produced. Finley and Brenner (1941) found in animals that single insulin comas of up to four hours' duration leave only reversible changes, while after a coma lasting about nine hours, severe cell change of an irreversible nature and acute reaction of the glia were observed. Repeated prolonged shocks led to extensive damage to the nerve cells of the cerebral cortex and basal ganglia, and to gliosis in these regions and generally within the white matter. It is difficult, however, to state from clinical experience the length of time required to produce irreversible changes, as the brain cells of different individuals probably vary in their ability to recover from an attack (Lawrence, Meyer and Nevin, 1942). Experience suggests to these authors that coma of one to three hours is usually associated with complete recovery, while longer periods are dangerous.

A number of fatalities occurring after therapeutic application of *metrazol* and related drugs have been investigated pathologically. Death was attributed

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to organic disease of the heart and blood vessels (endocarditis, Buerger's disease) by Hayman and Brody (1939), and Michael and Wittenbrook (1940). The first-mentioned authors also refer to earlier, similar observations of death caused by aortic disease, pelvic thrombo-phlebitis, bilateral hypernephroma, etc. In the case described by Pessin and Reese (1939) acute cardiac dilatation may have been a contributory cause of death. A rare fatal complication appears to be fat embolism from a fracture produced during the convulsions (Nightingale and Meyer, 1940).

Various cerebral lesions have been described in fatal cases: Focal changes in the cortex and basal ganglia (Fellows and König, 1939); petechiae, oedema and acute swelling of nerve cells in striate body, thalamus and cerebellum (Pessin and Reese, 1939); generalized ischaemic disease of nerve cells and gliosis (Petersen, 1939); bilateral softening of the frontal lobe (Jansen and Waaler, 1940); oedema and softening of the cerebellum following injection of triazol (Wyllie, 1940). Marked diffuse hypertrophy and hyperplasia of astrocytes and, to a lesser degree, of the microglia was the outstanding feature in six cases investigated by Weil and Liebert (1940), and a similar glial proliferation was briefly described by Meyer (1939) in two cases complicated by myocardial degeneration and pellagrous change following ulcerative enteritis respectively.

There has been much controversy about the severity of the lesions after convulsions, produced by metrazol, in experimental animals. Reitman (1938), and Cleckley, Bowles and Mettler (1940) found serious lesions, especially gross haemorrhages and necrosis, but they obviously did not use "therapeutic" doses. Arieti (1941) observed only mild or even no changes, although he continued the injections until four of the five monkeys died spontaneously in protracted convulsions. The severity of the lesions was not proportional to the dosage or the number and duration of the fits. All the animals had an interstitial or parenchymatous nephritis, possibly of tuberculous origin.

The following groups of workers arranged their experiments in order to imitate strictly the therapeutic situation. Liebert and Weil (1939), using rabbits, found hyperplasia and hypertrophy of all types of glial cells more pronounced in the striate body and hippocampus than in the cerebral cortex. The nerve cells showed some shrinkage of cytoplasm and nuclei. Strecker, Alpers, Flaherty and Hughes (1939) described vacuolization of nerve cells and subarachnoid haemorrhage in four out of seven monkeys. Winkelman and Moore (1940) found no degenerative changes of nerve cells apart from occasional nuclear pyknosis. Whitehead, Neubuerger, Rutledge and Silcott (1940) found in three dogs and four rabbits small local areas of cortical necrosis with slight glial reaction, in addition to diffuse degenerative changes in nerve cells. Similar slight changes were seen by Finley and Brenner (1941) in monkeys. Neumann, Cohn and Katzenelbogen (1942) described in cats petechial haemorrhages and scattered cytolytic changes in nerve cells, which they also saw, however, in normal controls.

An original approach to the problem of the immediate and reversible changes produced by convulsions has been made by Heilbrun and Liebert

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(1941). Using biopsy material they studied nerve-cell changes after administration of metrazol, monobromidated camphor, thujone, insulin, nitrogen, air embolism and electricity. Pieces of the brain were taken out 2, 5, 10, 20, 30, 45 and 60 minutes after administration of the convulsive agent. Swelling, tigrolysis, eccentricity of the nucleus in nerve cells and swelling of the astrocytes and oligodendrogliocytes were observed, commencing five minutes after administration, and gradually disappearing after 30 minutes unless a new convulsion occurred. The changes were—surprisingly—most marked in electrically produced convulsions, and occurred even after subconvulsive doses, eliciting only myoclonic twitchings. The same authors (Liebert and Heilbrun, 1940) studied cell changes by means of microincineration. Dust formation, hypomineralization and even complete demineralization, particularly marked in Ammon's horn, were seen to follow immediately after the seizure, and they were to some extent reversible. Nissl stain need not reveal any changes when hypomineralization was readily demonstrable.

Apparently no human brains after electro-convulsive treatment have been investigated, but a few experimental investigations have been carried out. Heilbrun and Weil (1942) found in most of their experimental animals haemorrhages in meninges, brain stem, spinal cord, and also in lungs and kidneys. They considered a combination of pathogenic factors such as sudden rise of arterial pressure, vasospasm and venous stasis. Neither generalized nerve-cell changes nor glial reaction were seen. Although the authors considered the shock given to their animals to be similar to that given in psychoses, it is noteworthy that 16 of their 28 rabbits were paralysed afterwards; 7 even after the first shock. In the discussion Hassin stressed the discrepancy between these results and negative findings in human brains after electrocution. Alpers and Hughes (1942) used threshold currents in 30 cats. Subarachnoid haemorrhage of mild degree was found in 14 animals; intracerebral haemorrhages, usually of the punctate type, were produced in the cerebral cortex, white matter, cerebellum and the grey matter around the third ventricle of nine animals. No relationship existed between the severity of the lesion and the number of shocks and the interval at which they were given. Dogs were used in so-called "therapeutic" experiments by Neubuerger, Whitehead, Rutledge and Ebaugh (1942). The animals were rather unruly during the period of the "treatment." Histological examination revealed petechiae, widespread changes of the cortical nerve cells (tigrolysis, swelling, vacuolation and—focally—ischaemic and severe degeneration) and a slight proliferation of the neuroglia and microglia. All the changes were especially marked in the pathway of the electric current. Both a direct effect upon the nervous parenchyma and a general contraction of intracranial arteries are considered as factors operative in the causation of the lesions, which, although definitely pathological, are regarded as light, and as undoubtedly less severe than after metrazol convulsions.

In conclusion, the present situation may be summarized as follows: The nature and extent of the lesions produced in irreversible hypoglycaemic coma are now comparatively well known, but there remains some uncertainty as to what happens after uncomplicated insulin treatment. No systematic investigations in treated cases dying from intercurrent diseases have been so far made,

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and the experimental approach to the problem, although supplying valuable information, has not yet been wholly satisfactory.

It seems to be established that the lesions in cases dying from convulsive treatment are, on the whole, less severe than those seen after fatal hypoglycaemia. With regard to the sequelae of uncomplicated convulsive treatment we again depend almost entirely on experimental work, and although recently workers have tried to imitate the therapeutic procedure, the experimental conditions are not wholly comparable to those in man. Generally speaking, the reported changes in the brain did not appear to be serious—after electroconvulsive treatment even less so than after metrazol convulsions. Many of the acute changes, including small haemorrhages, may be reversible, and others such as a mild proliferation of the glia need not be of great importance. It is too early, however, to pass a final judgment upon this point.

Some of the changes seen after artificially produced convulsions are, in quality at least, similar to those seen in idiopathic epilepsy, although the characteristic necrosis of the Sommer sector in the Ammon's horn and of the Purkinjë cells in the cerebellum do not appear with the same frequency. It remains to be seen whether this difference is due to the relative smallness of our present experience, or possibly to more fundamental causes.

It is beyond the scope of this review to deal with the purely metabolic aspects and theories of shock treatment, but it may perhaps be useful to mention a few recent biochemical investigations on the effect of insulin and convulsive treatment. Loman (1941), examining sugar and oxygen metabolism during and after hypoglycaemia, failed to detect any sign of metabolic stimulation. There was no appreciable difference in the gaseous constituents of the blood before and after insulin and metrazol treatment (Harwitt, Liebert and Wiltrakis, 1940) nor any effect on blood pyruvates, lactates and glucose (Elliott, Rivers, Elliot and Platt, 1941). An alteration of the albumen : globulin ratio in the cerebrospinal fluid has been reported after insulin and metrazol shocks by Kingsley and Freed (1941). For earlier references the reviews by Lawrence, Meyer and Nevin (1942) on hypoglycaemia and by Kennedy (1940) on convulsive treatment should be consulted.

Oligophrenia.

Various aspects of the group of diseases known as *lipoidosis* have recently been investigated. New cases with unusual features were described and attempts made at clarifying the relationship between the individual members of the group, particularly from the chemical point of view.

Hallervorden (1938*a*) investigated a late case of amaurotic idiocy, with onset at the age of 33, progressing slowly for about 20 years. The clinical symptoms pointed to a predominant affection of extrapyramidal centres. Histologically the most intensive lipoid deposits were found in the cells of the striate body, hypothalamus and the cornu ammonis.

Norman and Wood (1941) described a congenital form of amaurotic idiocy with onset in foetal life. An unusual feature was heavy extracellular lipoidal deposits in the white matter, which have some resemblance to those seen in

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the Schüller-Christian type. This latter condition has been the subject of a study by Hallervorden (1938*b*). He separates two groups: the Schüller-Christian syndrome, in which cholesterolesters are deposited in the brain, the lesions being patchy, and cholesterinosis characterized by cholesterol deposits and diffuse lesions. Cholesterol is hydrophobic and remains in the tissues after secretion from the blood, while the esters are more easily taken up by cellular elements. The brain stem and cerebellum are predominantly affected; only in one case previously described by Davison had the cerebral hemispheres been found involved.

There have been no noteworthy developments regarding the pathology of gargoylism (chondro-osteo-dystrophy of the Hurler type) since Ashby, Stewart and Watkin (1937) established the similarity of the nerve cell changes with those found in the juvenile form of amaurotic idiocy. The six cases occurring in one family, described by Jervis and Thiells (1942) showed some unusual features, especially later onset, absence of the grotesque facial appearance, and no enlargement of liver and spleen, which in the opinion of the authors separate them from the closely allied Hurler condition.

The relationship between Niemann-Pick disease and amaurotic idiocy has been much investigated. Scheidegger (1941) believes that both conditions are identical, and Hagedorn (1940) said the same with regard to the retinal changes. Rothstein and Welt (1941), however, while acknowledging an interesting interrelationship, advocate that the term amaurotic idiocy be reserved for cases with involvement of the central nervous system only. They give a comprehensive review of all types of lipoidosis, with the main differentiating pathological findings in tabular form. The difference between the two conditions has been also pointed out by Jervis (1940). In amaurotic idiocy some lipoids of the "protagon" type are increased and not sphingomyelin. The chemical investigations by Klenk (1939, 1940), which were not available for detailed study, apparently support this separation, which had previously been suggested by Epstein. In an interesting experimental approach Ferraro and Jervis (1940), using rabbits and monkeys, found after intravenous injections of sphingomyelin changes strikingly similar to Nieman-Pick disease. They failed, however, to produce a storage of sphingomyelin in the brain, which, in their opinion, indicates a difference between this condition and amaurotic idiocy.

Sjövals' theory that the lipoid storage in nerve cells in amaurotic idiocy is the expression of a rapid and premature senescence has been repudiated by Dide and van Bogaert (1938) and Jervis (1941), the latter pointing out that in contrast to senile changes there is no cell atrophy in amaurotic idiocy.

Norman and Wood (1941) have criticized the term lipoidosis as being too vague, since in most cases the lipoid deposits are confined to certain organs and are not generalized. This objection may have been met, to some extent, however, by Jervis and Thiells (1942), who advocate the concept of "localized lipoidosis."

Alexander and Myerson (1939) studied the brain in amaurotic idiocy and other conditions by means of micro-incineration. The nerve cells in amaurotic idiocy are demineralized, while the glia contains an excess of heat-resistant ash. Hypermineralization is, as in all blastomatous cells, the characteristic sign of

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tuberosclerosis. The periventricular spongioblastoma often associated with this condition may even show gross hypermineralization. The nerve cells in mongolian idiocy appear normal.

The problem of *mongolism* has been studied from many aspects within the period under review. Benda (1939*a* and *b*) studied the thyroid and pituitary glands cytologically. In the former involutional changes were very constant, indicating preceding hyper- or dysfunction. The changes resembled those seen after administration of thyrotropic hormone. In the pituitary the frequency of relative eosinophilia may be caused by pituitary deficiency of the mother during pregnancy. Several papers by the same author (1939*c* and *d*, 1940) deal with problems of growth and physical development in mongolism, 120 cases serving as basis of the investigation. Mongolism must be due to prenatal factors, since it is already present at birth. Rate of growth is low during the first nine years, and usually stops after the fifteenth year. Dystrophia adiposogenitalis is frequent after puberty. The peculiar shape of the skull is due to arrest of development of the base. An irregularity of ossification can be demonstrated by X-rays and by histological examination.

All the changes suggest to this author a congenital absence or deficiency of hypophysial or extrahypophysial hormones stimulating differentiation and growth. There is, however, no evidence that the "growth" hormone of the anterior pituitary is responsible.

Bixby (1939, 1940, 1941) has contributed several biochemical investigations into mongolism; his main points are that the blood groups are those of the average American population, thus excluding any relation to the Mongolian race. The basal metabolic rate, serum cholesterol, blood sugar, glucose tolerance, although singly within normal range, may collectively indicate hypofunction of the anterior pituitary. This is also suggested by a delayed glycaemic response after insulin. The initial lesion may have been caused by temporarily or permanently high levels of cholesterol in the maternal blood. The author himself admits, as does Schachter (1941), the difficulties of interpretation of the biochemical findings. Himwich and Fazekas (1940), examining samples of arterial and venous blood, concluded that less sugar and oxygen are utilized by the brain in mongolism, as well as in phenylpyruvic oligophrenia.

A neurohistological study of mongolism has been made by Meyer and Jones (1939); they found histological changes, often of marked degree, in a large percentage of mongols, but do not consider that they represent the pathological substrate underlying mongolism. They may be caused, however, by concomitant factors in mongolism, such as frequency of birth injury, congenital heart disease, susceptibility to infection, etc.

Norman (1938*b*) made a *cytoarchitectonic* study of the supragranular cortex in 30 normals and 30 mental defectives (cases with gross pathological lesions being excluded). He used frozen sections in order to avoid shrinkage and he chose three areas for comparison (OA, FE, PF). He found no significant differences between the two groups in regard to average depth of the cortex and the number of cells, but he occasionally found an excess of neurones in the visuopsychic area of oligophrenics. The arrangement of the neurones in the middle portion of the supragranular cortex was less uniform and regular than in

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the normal brain. Diminution of normal spacing between poorly developed nerve cells is highly characteristic of the oligophrenic. There were no significant differences between mongols and other varieties of mental deficiency.

A number of authors have studied various types of *malformation* of the brain. Jakob (1938) tried to group the different types from a genetic point of view, based on the earlier theories of Bielschowsky. Benda (1941) made a histological analysis of a microcephalic case showing both macrogyria and microgyria interna. In another microcephalic, cystic degeneration, probably due to birth injury, was found. Walker (1942) described the changes in a case of lissencephaly (agyria). Only five similar cases were found in the literature. The cerebral cortex was arrested at the stage of development normally occurring in the third month. Except for the "*Randschleier*" no cortical lamination was seen. The white matter was narrow and heterotopias frequent. The basal ganglia and brain stem were well developed, but the cerebellum and olives were hypoplastic. Arhinencephaly was the subject of a paper by Stewart (1939*a*). Despite complete absence of olfactory bulbs and tracts, there was no abnormality in the hippocampal convolutions. Only the fascia dentata was reduced in size. There is no obligatory parallelism in the development of the frontal lobe and hippocampus, although maldevelopment of both may occasionally occur together. An important study into the problem of porencephaly has been made by Yakovlev and Wadsworth (1941). They discriminate between schizencephalies (developmental abnormalities) and encephaloclastic porencephalies. In the former variety there is a continuity of the walls of the cavity with the ependyma of the underlying ventricle through a pia-ependymal seam. The clefts follow the gyral pattern.

A comprehensive review on *cerebral diplegia* based on the histological examination of 50 cases has been given by Stewart (1942). He arrives at the conclusion that no single cause common to all cases can be assumed in view of the diversity of the lesions. The frequency of micrencephaly and of normal birth suggests that birth injury as a causal factor has been overrated. Many of the lesions can be explained by Collier's conception of primary degeneration. In others, anoxaemia and nutritional deficiency may be important factors. With regard to anoxaemia, the frequency of cerebellar changes, especially the loss of Purkinjë cells, which are known to be particularly susceptible to oxygen want, is of interest. Nutritional deficiency is suggested by the prevalence of demyelination, and by certain other characteristics. For more detailed information the original paper should be consulted.

It is impossible to give a complete survey of the numerous papers dealing with rare conditions and even rarer combinations which may occur in defectives. Only a few examples can be incorporated into this review.

Peters (1939) introduces a new theory to explain the hemiatrophy in Sturge-Weber disease. According to him, the multiple angiomatosis is congenital. The cortical atrophy, however, is probably produced by chronic disturbance of the circulation due to the diseased meningeal blood vessels and also to the vasomotor disturbances accompanying the epileptic convulsions. The calcification in the cortex originates to a large extent from the blood vessels.

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The condition known as status marmoratus has been the subject of several important contributions. Scholz, Wake and Peters (1938), after giving a comprehensive review of the literature, reported the results of histological investigation of eight new cases. They confirm the view first introduced by Scholz, and subsequently held by other workers, including the present writer, that the marbling occurs within glial scars. There is evidence, illustrated by ischaemic changes, in an early case of their material, that the original lesion giving rise to hypermyelinized scars is caused by oxygen want. Norman (1938*a*) found also extensive glial scarring in his case, but he was not convinced that this is directly connected with the production of status marmoratus, which may be due to malformation, as it had been originally assumed to be by C. and O. Vogt. An interpretation also based on the theory of malformation, but in many regards quite novel and almost sensational, has been offered by Alexander (1942). Studying four cases of this condition by a careful histological technique, including examination in polarized light, microincineration, and benzidine stains, this author arrived at the conclusion that the assumption of a hypermyelinized glial scar is incorrect. The corpus striatum in all its histological components is normal. The marbling fibres constitute an accessory tract (fasciculi marmorantes) and are branches of the tractus marmorans, which probably is part of the fronto-pontine fibres in the internal capsule. In cases of striatal status marmoratus the caudal portion of the fronto-pontine tract in the midbrain and pons is absent or reduced in size, corresponding in degree to the number of marbling fibres in the striate body. The occurrence of marbling within the thalamus is explained similarly; it is followed by diminution in size or paucity of fibres in the reticular substance of the medulla. The occurrence in the normal striate body of the shrew of a fibre tract to some extent resembling marbling is taken as evidence in favour of malformation.

It would be premature and also beyond the scope of this review to comment upon Alexander's important investigation, which is likely to arouse a lively discussion and stimulate new work.

A comprehensive review has been written by Fitzgerald, Greenfield and Kounine (1939) on the sequelae of "*Kernicterus*." They were able to add two personal cases with pathological investigation. In both cases the globus pallidus, nucleus subthalamicus, Ammon's horn and fascia dentata were affected. The condition is interesting because of its relation to similarly localized lesions encountered in defectives; for example, it may throw light on the pathogenesis and certain histological features of status dysmyelinisatus. Icterus in the adult does not usually stain the brain, but nerve cells and scavenger cells in areas of degeneration have an increased affinity to the pigment, as has been recently shown by Rutledge and Neubuerger (1942).

A lesion in some of the hypothalamic nuclei has been found by Stewart (1938) in a case showing the symptoms of pseudo-aphroditism, adiposity, polyuria and hypoglycaemia. The same author (1939*b*) investigated the brain and organs of a case of the syndrome of Rud (combination of congenital ichthyosis with infantilism, idiocy and epilepsy).

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1. INTRODUCTION, DEFINITION, CLASSIFICATION, THEORY.

NEW methods of physical treatment introduced during the last decade have revived the general interest in schizophrenia, the "Cinderella of psychiatry" (Ellery, 1941). The fact that schizophrenic symptoms can be influenced by crude physical means such as convulsions, hypoglycaemia or operations on the brain has directed the attention to the bodily disturbances underlying the psychological symptoms. The need for accurate assessment of results of these treatments has also revived the interest in prognosis. Kraepelin, who, in 1896, "by a streak of genius" (Adolf Meyer) unified varied clinical pictures in what he called dementia praecox and considered it a disease entity, never doubted its causation by a brain process of organic nature. Nor did Bleuler, when he tentatively proposed the term "schizophrenias" for approximately the same group of cases in 1911 in which he found a common primary psychological disturbance. Those interested in the meanings of "splitting" as expressed by the term schizophrenia will find a discussion of possible misunderstandings in an article by Lewin (1939).

Kraepelin's and Bleuler's views are compared and contrasted with those of Adolf Meyer's on what he named parergasia in a paper by Katzenelbogen (1942). Meyer did not accept the organic aetiology, "for the reason that heretofore it has not been supported by adequate factual material." He waived the idea of disease entities even as an aim and introduced the schizophrenic reaction type; but it is worth recalling how much his psychodynamic interpretation is akin to Bleuler's. Both emphasized the prepsychotic handicaps of many schizophrenics which make their adjustment to the problems of reality difficult; both considered subconscious complexes the cause of conflicts preventing adjustment; and both included in the concept of schizophrenia schizoid personalities who remain so all their life without ever suffering from psychotic attack. Meyer added "habit deterioration" as an important element in the familiar picture. Katzenelbogen's summary of Bleuler's work is especially welcome because the latter's original monograph has never been translated into English, and the inadequate translation of his text-book gives no idea of his "elaborate, explicit and comprehensive" analysis based on a broad clinical material. Kraepelin's later views were influenced by

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Bleuler ; he even admitted the idea of reaction types instead of disease entities ; but his clinical description has, according to Katzenelbogen, not been surpassed either by Bleuler or by Meyer. " It has stood the test of time and probably will remain a classical model."

It seems appropriate to mention that Bleuler's death falls in the period covered by this survey, as also Rosanoff's, whose *Manual of Psychiatry*, in its seventh edition (1938), is probably the only modern text-book which does not mention schizophrenia at all. The corresponding clinical descriptions are found under " chaotic sexuality."

As long as aetiology remains obscure the definition of schizophrenia seems elusive ; but, as Mapother and Lewis (1941) have pointed out, it is possible for two experts to disagree about what should properly be included, yet over the diagnosis of any particular patient they will attain a measure of agreement and certainty surprising to those who know the condition only from reading or limited experience.

Meanwhile the lively argument for clearer theoretical boundaries continues, kindled by dissatisfaction with the clinical polymorphism at present comprised under the concept, and by the search for a " nuclear " group of more homogeneous nature. Skottowe (1939) suggested " dys-symbole " as the name of a disturbance of conceptual thinking which he demonstrated in a group of cases with insidious onset and hopeless prognosis ; they did not yield either to convulsion or to insulin treatment. Darrah (1940) proposed to call a similar group " dementia praecox," and leave the term schizophrenia for acute cases with " milder symptoms " and better outlook. Osborne (1940) would like to give up both terms, dementia praecox and schizophrenia, and suggests " palaeophrenia " as a name for all cases in which impairment of abstract behaviour and conceptual thinking is found by tests like those of Vigotsky, Weigl, Goldstein and Shipley ; they show, according to Osborne, regression to a more primitive type of thinking, hence his new term. Osborne makes light of the difficulty of excluding patients with paranoid and paraphrenic symptoms—a problem rock on which more than a generation of psychiatrists have stranded. The regressive nature of schizophrenic symptoms is also one of the topics in a purely speculative paper by Hecker (1941). Criticism of the subdivisions of schizophrenia is made in a follow-up study by Macfie Campbell (1943) of nine cases of what he calls schizophrenic " surrender," in fact typical cases of the hebephrenic type. Campbell is loath to call them so : " The technical terms usually given to these cases are so shop-worn and contaminated that one hesitates to circulate further this degraded currency." Another attempt to restrict the diagnosis schizophrenia to a more uniform group by Langfeldt will be discussed under " Prognosis."

Against these attempts to differentiate diagnostically important smaller groups of cases, the idea of amalgamation of schizophrenia with affective psychoses has been revived by Stanley Cobb in his *Foundation of Neuropsychiatry* (1941). He first turns against the use of the term " functional " for schizophrenia and affective psychoses because of their hereditary origin. " Structure is inherited, not function." Although Cobb agrees that typical cases are different and easily separated nosologically, he maintains that they

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are really nothing but the extremes of a continuous series of variables. The space between the extremes can, according to Cobb, be filled with a large number of mixtures which cannot be diagnosed as either. As mixtures are more common than typical cases, " one must logically admit that the two diseases are fundamentally one," the schizo-affective group. Thus schizophrenia, despite all theoretical and clinical work, has still to fight for its bare existence, even in one of the most up-to-date American introductions for practitioners and students.

2. Aetiology.

Hereditary factors are discussed in Chapter 3 of this survey.

The prepsychotic personality of schizophrenics has gained fresh interest because of the necessity of excluding prospective schizophrenics from service in the armed forces. Thom (1941) has calculated that the average cost of a schizophrenic taken ill during the last war until his death was $30,000, thus emphasizing the necessity of selective procedure. There are, however, no recent investigations dealing with predisposing factors in new material, only articles giving advice in general terms.

Bullard (1941) stresses the importance of minute signs of dissociation—Bleuler's dereistic thinking—in speech and behaviour, of the manner in which the examinee talks about himself, especially about his physical health, and of his lack of rapport with the examiner. There is a general agreement that a scientific weapon for sorting out prepsychotics does not exist, and that one has to rely on personal impressions and on the history.

Critics of Kretschmer's correlation between certain types of physique and schizophrenia have frequently pointed to the difficulty of ranging females within his types because their build is often indefinite. Elliot (1941) compared 100 female schizophrenics with 100 non-psychotic women of the same average age. The results were on the whole in favour of Kretschmer's view.

The rule that schizophrenia is equally frequent among all races is, according to Demerath (1942), still unproven for the case of primitives who have not been touched by civilization. Caravedo (1941), reporting on conditions in Peru, observed that most of the schizophrenics came from the mixed half-breed population, while the native Indian race seemed least affected; this, as well as the geographical distribution of the 2,500 hospital admissions on which the paper is based, was better explained by social conditions, prejudice against hospital treatment, etc., in the respective communities, than by racial differences.

Data on the social incidence of schizophrenia are the most interesting findings of research work carried out by Faris and Dunham (1939) in Chicago. The sociological structure of the different city districts was known from previous investigations. Faris and Dunham studied the pre-hospital residence in the city of all cases of mental disorder admitted to private and public hospitals within two years. The distribution showed a regular decrease from the centre, which had the greatest density of patients, to the periphery of the city. The pattern of distribution was similar to that of poverty, crime, unemployment,

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infant mortality, and many other social abnormalities. This distribution was especially characteristic for schizophrenia, while manic-depressives had a random pattern of incidence not clearly referring to the social differences in the city areas. Among schizophrenics the paranoid type followed the characteristic pattern more closely than other types. The complex nature of the economic and racial conditions does not allow a clear-cut explanation of these findings; the authors take great care in suggesting theories. The material is admirably presented in tables, graphs and maps.

Endocrines, which played such an important role among the probable aetiological factors of schizophrenia at one time, have been much less in the foreground of discussion lately. Interest in the sex glands has dwindled, while the thyroid and its connection with metabolic disturbances have attracted greater attention (see "Pathology").

The question how far schizophrenia can be caused or precipitated by physical or psychological stress is of practical importance under war conditions. As a basis for decisions of state insurance tribunals, a panel of five prominent Swiss psychiatrists (Kläsi *et al.*, 1939) have published a report on the question of attributabilty of schizophrenia to military service under peace conditions. After many quotations, mostly from German literature on the subject, they came to the following conclusions: (1) Schizophrenia is a hereditary and endogenous disease, therefore in no causal relation to military service. (2) There are two exceptions: (*a*) reactive schizoid psychoses clearing up within a short time; (*b*) rare atypical, schizophrenia-like psychoses occurring in previously healthy people after a severe injury or damage to the brain. Compensation should be granted for a few months in the reactive schizoid psychoses (*a*); if the patient is not cured within this time a new expert opinion on the case should be asked for, which will probably establish that the schizophrenia was an endogenous one. The cerebral damage in the schizophrenia-like psychoses (*b*) may be of traumatic, infectious or toxic origin; these cases are fully attributable to service conditions. In general the report holds that schizophrenia cannot be permanently aggravated through military service, but psychological and physical experiences under service conditions may accelerate the onset of a schizophrenic attack which would have occurred some time later without service. In such cases it is suggested that compensation should be granted up to the maximum time of one year. Every case of this kind, however, has to be decided on its own merits; the decision should be based on the expert opinion of a psychiatrist.

Maclay and Guttmann (1940), discussing the war as an aetiological factor in schizophrenia, take approximately the same line. Psychological and physical stress can precipitate or hasten but never cause schizophrenic illness. If such precipitation is probable they suggest compensation for 6 to 18 months according to the circumstances of the case; beyond this the disease or relapses are not attributable. They also recognize the rare instances in which psychotic states after head injury, severe bodily illness or "psychological shock," may merge into chronic schizophrenic illness in uninterrupted sequence, and regard such cases as caused by the service. Difficulties can be foreseen in the possible interpretation of the term "psychological shock."

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Cerebral injury and schizophrenia is discussed in a paper by Feuchtwanger and Mayer-Gross (1938) presenting in detail 23 cases from the last war. Most of these were found among over 1,500 pensioners controlled by the Munich head injury centre. The percentage of schizophrenia-like psychoses and schizophrenias together among this material was four times that calculated by other workers for the average German population of the same age-group. Without the schizophrenia-like psychoses, most of which were schizophrenic pictures in cases of post-traumatic epilepsy or traumatic dementia, the number of " pure " schizophrenias among the head injured was not significantly higher than in the average population. The case-histories, many of them followed up till 1930 and later, illustrate the various combinations of schizophrenic symptoms with defects due to cerebral damage with and without epilepsy. Frontal damage was almost twice as frequent among the patients with schizophrenic symptoms as in the total material, while parieto-temporal lesions were correspondingly rarer ; more detailed correlation between symptoms and site of injury could not be established.

The views on the role of mental deficiency in the incidence of schizophrenia are still highly contradictory. In a group of over 2,000 antisocial and excitable defectives James (1939) diagnosed three-quarters of the small number of psychotics as schizophrenia. Kallmann and his collaborators (1941) have surveyed the literature, and pointed out the difficulties of the problem and the inconsistencies in terminology. They tried to distinguish between idiopathic, symptomatic, and exogenous forms of either group, and found no evidence that mental deficiency is a predisposing factor of schizophrenia. Using statistical data from genetic research and twin studies, they found no evidence either of an increased incidence of schizophrenia in the consanguinity of mental defectives or of an increased tendency of the blood-relatives of schizophrenics to be feeble-minded. Combinations exist, but not more than could be expected by chance ; the idea of an unspecific inheritance leading to alternative incidence of mental deficiency or schizophrenia, as suggested by Rosanoff, was not supported by the authors' work.

3. Pathology and Physical Symptoms.

Since the spell of frustration hitherto cast over studies on metabolism in schizophrenia was broken by Gjessing's work on periodic catatonia, investigations have been eagerly resumed in many places ; but only a few workers have followed his method of long-section serial studies in a few patients who served as their own controls. War has considerably delayed progress. Before Gjessing's publications and, perhaps, his work were stopped by the invasion of Norway, he published the results of thyroid treatment which he regarded as a kind of verification of his working hypothesis. By the phasic variation in total nitrogen balance and in autonomic function which he found associated with the periodic mental changes, he had opened up two ways of approach to the pathology of schizophrenia, the study (*a*) of liver and thyroid function because of their regulating and controlling role in nitrogen metabolism, and (*b*) of the autonomic changes themselves.

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Investigation of the total metabolism in periodic catatonia modelled on Gjessing's work was carried out by Hardwick and Stokes (1941) in one patient and one control case over 18 months. They confirmed the association of stupor periods with negative nitrogen balance, and found a weight of evidence against the simple view that the nitrogen change is secondary to the mental disturbance. On the other hand, when a high level of general nutrition indicated by increased body-weight was attained, the rhythm of mental disorder persisted without parallel nitrogen over-excretion. There were some other points in which Stokes' results differed from those of Gjessing; but as their work was interrupted by the war, their only conclusion is a pointer to the urgent problems awaiting solution.

Serial studies of protein metabolism were also carried out by Greving (1941), following up his former work with Jahn. From the abstract of his publication which is available at present, it appears that he confirmed what Jahn called "asthenic metabolic changes" occurring in schizophrenics as well as in schizoid psychopaths, and contrasted them with findings in pyknic, cyclothymic patients. The asthenic changes are, according to Greving, the basis of the somatic syndrome in schizophrenia. In the four schizophrenics he investigated, he found "nitrogen retention preceding the onset of an active psychotic phase; furthermore, disturbances in urea synthesis and in esterization of cholesterol, all of which were attributed to pathological fermentative action of the liver." These changes disappeared in patients with good remissions, but an unfavourable course in patients with nitrogen retention persisted, in spite of strong metabolic stimulants, such as artificial fever. Further proof of the importance of nitrogen retention due to a faulty liver function was seen in results of phlorizin experiments. In clinically unalterable stupor cases phlorizin produced no increase in nitrogen excretion, despite the great loss of sugar, while nitrogen excretion increased parallel with sugar excretion in prognostically favourable cases. Another interesting observation mentioned by the same author was that of nitrogen retention in animals poisoned with mescaline. Excretion returned to normal after withdrawal of the drug, which in man produces many schizophrenic symptoms (Agadjanian, 1940; Stockings, 1940).

Tests of liver function were carried out by Quastel and Wales (1938), using Quick's method of detoxication of benzoic acid. In a preceding paper with Wheatley, Quastel had shown that certain intermediary products of protein metabolism inhibited oxidation in brain tissue just as narcotics do. Eighteen catatonic patients showed a diminished excretion of hippuric acid in the urine, indicating a disturbance of the detoxicating process of benzoic acid, while in non-catatonic schizophrenics and in other patients the results were normal. Ström-Olsen and his collaborators (1938), however, could not confirm these findings. In their material the proportion of cases with low excretion of hippuric acid was about the same in catatonic as in non-catatonic schizophrenics. Quastel and Wales (1940) repeated their experiment in twelve catatonics, each of whom excreted definitely less than the normal value. To avoid delayed absorption of benzoate from the intestine as a possible factor, they gave it intravenously with the same result. Davies and Hughes' (1940)

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results in 45 schizophrenics of which 17 had catatonia were on the whole in favour of Quastel's statement, but they do not regard the phenomenon as specific for catatonia, because they found low excretion in a number of non-catatonic patients. The explanation that the results in catatonics could be due to their muscular rigidity and immobility was suggested by Finkelman and co-workers (1941), but Gildea reported two patients immobilized in a plaster cast for three months, who responded normally to an intravenous hippuric acid test. Berkenau (1940) tested a relatively small mixed group of patients with a battery of liver function tests. Quick's benzoic acid test gave low values of excretion in all his patients with catatonic features, among whom were a number of depressions and involutional melancholias.

The hypothesis of a toxic substance, possibly an amine, being responsible for the mental and autonomic changes in periodic catatonia was criticized by Richter and Lee (1942). They argued that the retention of nitrogen observed by Gjessing applied to all nitrogen degradation products found in the urine, and proved nothing about a single protein intermediate which might have a toxic effect. They tested by new methods of their own the blood of a mixed group of psychotics, among whom were 19 schizophrenics, for both simple amines and lipids containing an amino-group. No increase of the former was found, but a statistically significant increase of the amino-lipids was obtained in schizophrenics. This work suffered from the frequently deplored shortcomings of psychiatric biochemistry; it did not deal with a clinically homogeneous material, and took no account of the condition of the patient at the time of the test.

Thyroid treatment was applied by Gjessing (1939), not as substitute therapy for hypothetical hypothyroidism, but to catabolize body nitrogen in order to prevent the storage of nitrogen and its supposed toxic effect. He placed his cases on a low protein diet, and gave thyroxin in an ascending scale of dosage up to the point of mild intoxication; he followed it up with thyroid gland extract to maintain the nitrogen depletion. From his parallel studies of the metabolism, there can be no doubt that he succeeded not only in compensating the somatic disturbances in the four cases published in his last article, but also in abolishing their periodic psychoses (stupor or excitement). Hardwick and Stokes (1941) have tested his method in six similar cases with, on the whole, identical results. Their clinical criteria for exhibition of thyroid are: A rhythmic illness, association of the phases of illness with rise in temperature, pulse-rate and blood pressure, good tolerance of thyroid, and increase in weight during treatment.

For selecting the type of schizophrenic likely to respond to thyroid treatment, Sargant, Frazer and Brazier (1938) used the impedance angle, because they observed that a rise of its value coincided with spontaneous recovery in psychotics. Patients with a low impedance angle seemed to derive the greatest advantage from the drug, while in a case of quiescent schizophrenia with a high impedance angle before treatment the symptoms were activated by thyroid.

For a long time clinical observers have recognized that hyperthyroidism among schizophrenic patients is very rare. Hemphill (1942) found only five cases of toxic goitre among 4,750 psychotics of the Bristol Mental Hospital,

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and described a clinical syndrome which he considered characteristic for "hyperthyroid catatonia."

Massive and prolonged medication with thyroid has no toxic effect in chronic schizophrenics. Cohen (1939) applied the desiccated gland to eight patients in a state of advanced deterioration. Somatic reactions included: increase of basal metabolic rate, of pulse rate and pulse pressure, loss of weight, etc., but not the expected degree of hyperthyroidism. The psychiatric changes produced were only quantitative; more repetition and more perseveration of the patient's usual primitive, highly automatized activities, no elaboration of symptoms, no qualitative change in delusions or hallucinations, etc.

Thyroid function as a link in the disturbed autonomic integration was the subject of a comprehensive investigation in 129 cases of early schizophrenia by Rheingold (1939). Non-protein nitrogen, carbon dioxide combining power, dextrose and cholesterol were tested in the blood, so were oxygen consumption, blood picture, blood pressure, pulse rate and weight, and the results analysed statistically. More than half of the subjects had been ill less than one month; the majority were hebephrenics, but the other clinical groups were represented as well. The most marked abnormality was the low oxygen consumption rate; but there were other signs of hypometabolism. Rheingold refers his findings to the thyroid because of the similarities in the somatic status of his patients with that in the non-myxoedematous form of hypothyroidism recently described by American workers. However, in search of causative factors he ends up with the hypothalamus. The failure of central autonomic regulation inhibits in the author's view the action of both the naturally produced hormone of the thyroid gland and the hormone introduced from outside if thyroid is administered.

This idea of a primary disturbance of central autonomic regulation in schizophrenia has found new support on most diversified grounds. Many writings are heuristic speculations only, like an article by Grinker (1939), who spoke about "deficiency in some central autonomic co-ordinating process" professing its speculative nature. He tried to link up the physiological abnormality with the psychopathology of instincts in schizophrenia. Referring to Hess's theory of autonomic functions in sleep and wakefulness, Boss (1941) collected interesting self-observations of schizophrenic patients about the depth and nature of their sleep and about their incomplete wakefulness in daytime. Loss of the diurnal rhythm is undoubtedly a symptom in many schizophrenics, and may be due to a failing central regulation in the hypothalamic region.

The striking autonomic symptoms observed during insulin and convulsion treatment are, according to Gellhorn (1938), mainly responsible for the efficacy of these treatments. He believed that the slackness of central autonomic function produced by the schizophrenic illness is thus overcome, and supported his view by insulin estimations in the blood of schizophrenics, in which he found a vago-insulin predominance if compared with normal subjects (Gellhorn, Feldman and Allan, 1942).

Correlation between size and shape of the cutaneous capillary loops and mental characteristics or types of constitution has been studied with the idea

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that capillaries are indicators of autonomic equipment of the subject. Olken (1939) has worked out a quantitative method of assessing capillaries. After testing 6,000 healthy persons of all ages, thus gaining a control material, he investigated 1,100 schizophrenics. Their capillaries showed striking deviations from the normal. The severity of the disease was expressed in the derangement of capillary structure, and the writer suspects corresponding anomalies of capillaries in the brain with disorders of circulation. As physical illness which might cause similar capillary pictures was absent in his cases, he concludes that "schizophrenia falls in the category of vegetative and metabolic disorders."

The most important argument against the view of a primary central autonomic disturbance is still the absence of any histological change in the hypothalamic region, but there is also opposition from the physiological and clinical side. Jung and Carmichael (1937), registering plethysmographic reactions after the immersion of limbs in water of varying temperatures, were able to explain all clinically observed vasomotor anomalies in catatonic stupor by the immobility of these patients. Vasomotor responses and central heat regulation were all found normal when tested under the scrutiny of experimental conditions. These findings were confirmed by Abramson and collaborators (1941) testing peripheral blood-flow. Rosenfeld (1938), giving a general survey of the role of the autonomic nervous system in psychoses, discarded from the point of view of the clinician the localization of schizophrenia in the vegetative centres without, however, denying the occurrence of marked autonomic symptoms in certain schizophrenic states.

There is much to be said in favour of a guiding formula through the many isolated and contradictory somatic abnormalities reported in schizophrenia. Hoskins, who devoted much work to this problem, has now suggested, in an article with Angyal and Freeman (1940), the application of the term "withdrawal" for both psychological and physiological changes. Withdrawal is "expressed psychologically in lack of interest, apathy and indifference," physiologically in a general hyporeactivity, a diminution of responsiveness to various stimuli. Hyporeactivity to metabolic stimulants was demonstrated in experiments with large doses of thyroid (Cohen and Fierman, 1938), and with dinitrophenol as an oxidative stimulant (Freeman, 1939). In a severe stress situation in which schizophrenics breathed hot moist oxygen, their autonomic responses were markedly below those of normal controls (Freeman and Rodnick, 1940). Hyporeactivity was also found as measured by the number of nystagmus beats resulting from caloric and rotatory stimulation of the vestibular nerve (Angyal and Blackman, 1941). Again, when guinea-pig serum (Molholm, 1942) was injected intracutaneously, the mean maximum area of erythema was significantly smaller in schizophrenics. They also proved more resistive to insulin, and showed less rise in blood sugar and less autonomic signs when adrenaline was given following insulin (Freeman, Looney, Hoskins and Dyer, 1943). Studying the effect of rotation on postural steadiness as expressed in the amount of the subjects' sway, again the schizophrenic subjects were less reactive than normals (Freeman and Rodnick, 1942).

Hoskins and his collaborators are aware of the complexity of the problem, and appreciate that in some respects the reactivity of schizophrenics is identical

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with normals or even increased. Dyne and Tod (1940), for instance, found the somatic response to adrenalin and doryl not different from that of controls. The " psychobiologic " approach to schizophrenic withdrawal certainly has provoked a number of specific studies. It remains to be seen if the hope of the introductory paper will be fulfilled, and the " concept (of withdrawal) which is used with a somewhat vague and general connotation gains a new and rather definite meaning."

Carbohydrate metabolism in schizophrenics was studied by Lofvendahl and Valatin (1941), using new physiological methods. In the blood of catatonic and of restless patients they found abnormally high values for bisulphite-binding substances, pyruvic acid and lactic acid, while in quiet patients the findings were normal. Two tolerance tests of lactic acid after injection of sodium lactate or of adrenalin also gave abnormal results in the same type of patient. The number of patients and of controls was relatively small. A more comprehensive investigation of this kind is suggested.

The final results of the enigmatic metabolism in chronic schizophrenics as expressed in the patient's body-weight were studied by Baganz and Norris (1943), who followed up the weight of 374 hospitalized patients over a period of eight years and compared it with that of the total hospital population. While the degree of malnutrition did not differ from the controls on admission, the proportion of schizophrenics showing underweight was 50 per cent. greater after eight years. More active patients lost less in weight than the quiet cases. The extent and degree of malnutrition was independent of the intake in calories. Whatever the nature of the unknown " factor lacking in the digestion, absorption or metabolism of schizophrenic patients," they easily gained weight when small doses of insulin were given, as demonstrated by the authors in a special group. Broch (1938), however, who examined 90 undernourished patients, mostly schizophrenics, in a Norwegian hospital, found their ascorbic acid level in the blood low and blamed inadequate diet.

Occasional abnormalities in the C.S.F. of schizophrenics, especially increased protein content, has been reported in the literature. Testing 1,281 patients of the Indianopolis State Hospital, Bruetsch and co-workers (1942) found an increase of protein in 5 per cent. of the male and 3·2 per cent. of the female cases. Only four times was the protein over 100 mgm. A few of the patients had a parentage suspicious of syphilis ; otherwise there was neither an explanation from the clinical observations nor from the post-mortem findings of two cases who had shown positive C.S.F. reactions.

The interest of the pathological anatomist in schizophrenia has recently centred around the cases of sudden death in catatonics. Single cases with post-mortem findings of vascular changes in the brain have been reported by Bruetsch (1940), Horanyi-Hechst (1940), and Malamud and Boyd (1939). Cases without cerebral lesion have attracted special attention in the hope of finding lesions indicating metabolic dysfunction. Palmer (1941) recently reported an observation clinically similar to Scheid's " febrile cyanotic syndrome," but with in addition intense fatty change of the liver. Fatty degeneration of the lobular centres was also present in five catatonics examined post-mortem by Gaupp (1940).

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An exhaustive study by Locher (1941) on sixteen cases of sudden unexpected death in catatonic states should remove much misunderstanding and controversy in this field. A critical survey of the literature is followed by the case-histories and full post-mortem findings of her own patients and the causes of sudden death in mentally normal people are discussed. In fourteen out of sixteen cases the fatal outcome could be easily explained by somatic findings, which were not clinically diagnosed because of the abnormal behaviour of the patient or were indirectly due to the psychotic condition, e.g. circulatory collapse during motor excitement in a long-standing cardiac failure, etc. Brain or liver changes were absent, and it was unnecessary to resort to the psychosis itself as the immediate cause of death. Of the two remaining cases one was a G.P.I. with catatonic symptoms, while the other showed the much discussed "brain swelling" which at one time was considered a common finding in catatonia. The author concludes that the "acute lethal catatonia" of Stauder, Scheid and others is very rare.

4. Psychopathology.

With so much attention centred around the somatic pathology of schizophrenia, literature on its psychopathology has become scarce and little work can be reported from the period covered by this survey.

A study on language in schizophrenia by Woods (1938) is based on the analysis of verbatim reports of conversations with 125 patients. The following are some of Woods' interesting findings: The schizophrenic used superficially conventional language to express vague emotional states instead of ideas; he condensed complex ideas with many associations in one single word or a short phrase; neologisms and metaphors signified purely personal connotations without effort to render them meaningful to the listener. More deteriorated cases tended to condense whole sentences in one word, the meaning of which was unstable and unprecise like their thinking. Significant according to Woods is the influence of the affect in all these anomalies, neither language nor thinking being primarily disturbed. Hence, like Bleuler, he considers the fundamental psychological disturbance of schizophrenia as affective.

Two hundred dreams collected from twelve schizophrenics by O. Kant (1926) were examined for any characteristic peculiarity. The dreams themselves showed no specific anomalies, but the patients often accepted them as if they were part of real life. Schizophrenic mechanisms were present in the dreams. Dream analysis proved useful for elucidating the psychopathological network of symptoms in dissociated cases, but was neither diagnostically nor therapeutically helpful.

Early schizophrenics of the educated classes are by far the most suitable subjects for studying the psychology of schizophrenia. Baynes (1940) described the analytical treatment of two cases with the method of C. G. Jung, using active fantasy production in drawings and interpretation of dreams. One patient was a talented artist whose published drawings are remarkable examples of schizophrenic art; the other was quite unskilled in drawing. Both produced a sequence of pictures expressing, according to Baynes, progress

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from schizophrenic symptoms through a stage of regression to final restoration on a religious basis. Following Jung's ideas on the psychology of schizophrenia, Baynes discussed the archaic contents of the unconscious which were accessible thanks to the lowering of conscious control. By the purposive direction of the libido into the unconscious and the expression of its contents in fantasy and drawing the patient was—in the author's view—helped to regain control over these archaic contents, which otherwise might have got the upper hand and led to a progressive schizophrenic psychosis.

The handicap in emotional expression so characteristic of schizophrenics was demonstrated by Reitmann (1939) in drawing experiments. He asked patients to copy from memory simple drawings of faces with laughing, crying, etc., expressions which they had been shown immediately before. While other patients did it without difficulty, the drawings of schizophrenics came out stiff and without expression, even if they were able to understand the expression of the original and spoke reasonably about it. Starting with details they ended up with some lines, but did not reproduce the picture.

Such experiments are closely related to Rorschach's ink-blot method, which yields characteristic results in schizophrenics (Benjamin and Ebaugh, 1938; Morhardt, 1941; Weil, 1941). Two Hungarian workers, Böszömeniy and Merei (1940), had the chance of testing a schizophrenic patient who had been tested by the same method before his psychosis. They found a qualitative change in reaction, affirming similar findings of Skalweit. Prevalent introversion before onset of the psychotic attack was replaced by extraversion during the psychosis. They interpret the change as a sign of removal of repressions through the disease.

Hemphill (1939) collected cases in which physical illness influenced the content of the patients' delusions. Together with Stengel (1940) he observed the psychological reaction of three paranoid schizophrenics to physical illness which involved an interruption of the body surface (wounds, disturbance of cutaneous sensitivity); all developed the delusion that something from outside intruded through the break in the body surface. The authors refer to the loss of stability of the boundaries of the ego characteristic of schizophrenia as the possible mechanism causing the idea of introjection.

An extensive investigation on the influence of imagery on the symptoms in nineteen schizophrenics was carried out by L. H. Cohen (1938) with test methods used in vocational guidance. He confirmed clinical impressions like that of the association in the same patient of hypochondriacal delusions and hallucinations of taste, smell, and kinaesthesia. Other conclusions, such as the difference of imagery in schizophrenics and normals, seem to be generalizations based on too small a group of patients and need further substantiation.

The question whether schizophrenia leads to deterioration in the sense of loss of abilities or material has been taken up by Lehrman (1940), who found twenty patients over sixty well adjusted to hospital routine, on parole, etc. He therefore favoured the view lately put forward by French writers that they are not deteriorated in the same sense as organic psychoses, and proposes the term regression for their handicap. It is significant that there were no catatonics among his cases. No special tests or experiments are suggested

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to differentiate between regression and deterioration. It is unlikely that the problem can be solved by such arguments on definition.

5. Clinical Picture and Psychological Symptoms.

(a) *Simple Type.*

Wyrsch (1940) adopted this stepchild among clinical pictures and analysed the histories of thirteen cases observed and followed up for many years. The results of this descriptive study confirmed the classical views on the type. Although Bleuler's primary symptoms were often not manifest, Wyrsch asserted that the cases could be diagnosed from their behaviour even without knowledge of their history. The course is insidious, leading slowly to destruction of the personality; productive symptoms are completely lacking. Shallowness of emotions, indifference or callousness, absence of will or drive and of any kind of periodicity are the main features. The patients have no feeling for their own shortcomings, no consciousness of the progressive change or of their isolated position in life, no complaints except perhaps some vague hypochondriasis. They find that everything they experience and do is natural. These patients were not mental defectives, although it can be appreciated from the description that such a misconception might arise. Loss of affective response is shown to be the leading symptom of simple schizophrenia.

(b) *Hebephrenic Type.*

No similar clinical investigations can be reported on hebephrenia. Thought-disorder, its principal feature, has mainly been studied with the help of special tests. The results are reviewed in Chapter 10.

Inappropriate laughter and silliness, so characteristic of hebephrenics, were the object of a study by Kant (1942*c*), who got relevant information from eight patients about the mechanism of their hilarity. They told him that their laughing was activated more easily since the onset of their illness and that it relieved their tension. He interpreted their descriptions as follows: The psychosis leads to a disintegration of the patients' personality. This is followed by an overwhelming sense of frustration, to which the patient reacts, not with despair, but with helpless mirth. Kant does not maintain that this is the origin of hebephrenic laughter, or even its meaning in every case, but considers that what he calls "loosening of the personality" in the beginning of the psychosis prepares for such an emotional reaction, which may become stereotyped and deprived of any content in a later stage of the illness.

Schizophrenic "Vorbeireden," talking past the point—"a false response of a patient to the examiner's question where the answer, although wrong, clearly indicates that the question has been grasped"—has been discussed by Anderson and Mallinson (1941) in an article on psychogenic episodes in major psychoses. This symptom often combined with hebephrenic silliness, did not differ in itself from similar responses in hysterical twilight states; differentiation was only possible from the setting in which it was observed.

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(c) *Catatonic Type.*

In an effort to clarify the picture of catatonia Sprague (1941) analysed the symptoms of 100 cases diagnosed as dementia praecox, catatonic type, in one of the New York hospitals during the past decade. His method is not statistical, and while he tried to establish a "fundamental pattern" of specific symptoms, his aim is not pure description, but the finding of a formula covering the motor as well as the ideational side of catatonia. He sees it in the "force concept." Force and power are displayed in the abrupt and violent muscular phenomena, in stupor, negativism, excitation and violence as well as in delusions of being influenced by the force of drugs, infection, electricity, telepathy, or any kind of persecution, etc. "Whether in the non-language purely somatic realm, or in the domain of thought, power seemed to be the chief focal interest." Surely it would need some forced interpretation to include the perplexity, bewilderment and sleeplessness of catatonics in a concept of this kind. The author does not suggest why there should exist in our normal language a concept covering the different aspects of an abnormal phenomenon.

Rosenthal (1939), who some years ago described attacks of wakefulness with immobility in narcolepsy, collected similar observations in schizophrenics. Spontaneous descriptions were rare, but on questioning, one quarter of 70 cases reported states of stiffness with immobility in the early stages of their illness. The symptom was sometimes accompanied by fear and fright, sometimes by hallucinations, but often without any content of psychological motivation, and consisted of a feeling of being spellbound, lasting from minutes to hours. Rosenthal discusses its relation to nightmares, to narcolepsy and encephalitis, and suggests a possible cerebral localization in the central autonomic region.

The catatonic pupil first described by Westphal in 1907 as a diagnostic sign and much debated since was the object of a clinical and experimental study by Levine and Schilder (1942). The mechanism of the inconstancy of pupillary reaction to light found in a certain percentage of catatonics, but also in some cases of alcoholism and encephalitis, has never been explained. The authors compared it with findings in anoxia, and after instillation of drugs like eserine, atropine, cocaine, and acetylcholine into the eye of normal controls. Their theory of an autonomic imbalance with parasympathetic predominance is in keeping with many other observations in catatonia. As to the origin of the phenomenon, the following observation was important: Pupillary reaction similar to that of the catatonic pupil occurred as an intermediate stage before complete fixation of the pupil following instillation of drugs like atropine.

(d) *Paranoid Type.*

C. W. Miller (1941) studied 400 cases in which paranoid symptoms were present. They were of various aetiology, including manic-depressive, involutional, senile arteriosclerotic and other organic psychoses. About half of the patients were diagnosed schizophrenia. He found much similarity of the clinical features in the various diagnostic groups. One of the most common occurrences in the whole group was inadequate or unsatisfactory sexual and

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marriage adjustment. Only 50 per cent. of the schizophrenics were what is usually called schizoid personalities in childhood; 280 of the total series had prepsychotic paranoid traits. A plausible immediate cause for the onset of the psychosis was surprisingly rare, and gross environmental factors did not play any definite role in the development of paranoid symptoms.

As to the various aetiological theories, the author found cases confirmatory of every theory, but no theory that fitted all cases, e.g. 12 cases could be adequately and convincingly explained by the psychoanalytic conception of paranoia; 36 could be fitted to this theory with some effort, but the majority defied explanation on this basis. He also mentioned cases without any paranoid symptoms in which all the causative factors stressed in the psycho-analytic theory were at work. The same was found to be true of other theories. Miller accepts Lange's idea of a "paranoid syndrome" which may appear in many settings, may play the chief role in one psychosis or only colour partially or transiently a non-paranoid illness.

In a second paper on prognosis in paranoid cases, Miller (1942) found that of 290 patients one-fourth had a "relatively good" outcome. After an informative survey of the factors which might be responsible for prognosis, he is unable to provide a general rule or an easy formula; personality and its assets, type of delusion and their fixity, age, insight, environment, all co-operate in forming the clinical picture and its course.

6. Social Effects of Schizophrenia.

Everyday experiences of the psychiatrist seen through the eye and studied by the methods of an anthropologist are the content of an article by Slotkin (1942). He studied the social interaction of a dozen schizophrenics who during three months came into a room with tables, chairs and games, and for two hours every afternoon were left to themselves except for the observer with his notebook. He collected striking illustrations of the private character of the patients' symbolism, of their lack of sympathy, of their inability to organize themselves socially and of their minimum of customs and co-operative activity. The author follows rather too readily the commonplace explanations of psychiatry by schizophrenic withdrawal and introversion, and offers no theory from his own scientific field.

It has been known since Rüdin's investigations of mental disturbances in prisoners with life sentence that many of them suffer from schizophrenia. Wilmanns (1940) reconstructed the life-histories of seven murderers transferred to a psychiatric hospital after showing signs of mental abnormality during imprisonment. In four it was certain and in the others probable that they had committed their crime in the prodromal stage of a schizophrenic illness. He quotes many similar cases from the literature, and surveys the psychological factors leading to unexpected acts of violence in the period of an insidiously developing schizophrenic psychosis. He also discusses the difficulties the judge and the psychiatric expert have to face in dealing with the responsibility of capital offenders when their crime has become a matter of public interest through reports in newspapers. He strongly objects to capital punishment,

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in such cases even if it may appear more humane than imprisonment for life, especially because of the indelible stain cast on the criminal's family.

7. Diagnosis and Differential Diagnosis.

If one resigns oneself to the Meyerian idea that psychiatric diagnosis is and never will be anything but a non-exclusive "shorthand description" of symptoms (Curran and Guttmann, 1943), one cannot expect much effort or progress in the diagnostic field. Consequently, American literature, on which this survey is mainly based, contained little worth recording. In contrast, Langfeldt (1939), who, like most Scandinavian workers, is strongly influenced by continental teaching, followed the example of Kleist in revising the diagnosis of schizophrenia in all cases in which he found no deterioration after 6–12 years. This is discussed under "Prognosis." Attempts to separate smaller, diagnostically more uniform groups from the bulk of schizophrenics are commented on in the introductory section (p. 231).

Diagnosis has not yet benefited from the results of biochemical or other physical investigations, some of which have been reported above. Lehmann-Facius' reaction (1937) for lipoids in the C.S.F., which claimed to be a diagnostic laboratory test for schizophrenia, has not proved specific when used by other workers (Roeder, 1939).

Early detection of schizophrenia has become a matter of special interest because of the better results of physical therapies in cases in which there has been little progression towards chronicity. D. E. Cameron (1938) studied the early symptoms from the histories of 100 patients in Worcester State Hospital. Tables of the non-specific and specific symptoms are given in the terms used by the patients' relatives and friends. Cameron also inquired under what social conditions and by whom the mental abnormality was first noticed and into the immediate cause for hospitalization. Better psychiatric education of the family doctor and periodic surveys of mental health in whole populations are some of his preventive suggestions.

A catalogue of the principal schizophrenic symptoms ranged in order of diagnostic difficulty in early cases was given in an article by Mayer-Gross (1938) mainly addressed to the non-psychiatrist.

Another practical diagnostic problem, especially of the psychotherapist, are schizophrenics whose illness begins in the form of a neurosis during which the typical symptoms make their appearance. W. R. Miller (1940) published a number of such cases in detail, but did not seem much interested in their early differentiation, though this may be highly important for the choice of an appropriate therapy.

O. Kant (1940*a*) has made a bold attempt to introduce the German concept of personality-stratification to English-speaking psychiatrists. Between the deepest somatic stratum and the highest psychological stratum there is an intermediary level which he calls the vital stratum. He illustrates by many examples that schizophrenic symptoms cannot be understood on the purely psychological level, that the vital stratum is frequently involved in the formation of symptoms. He sets out diagnostic criteria on which a distinction can

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be based whether a given symptom belongs to one or another stratum—has therefore to be regarded as neurotic or as schizophrenic—and shows how the specific schizophrenic characteristics may be explained by this working hypothesis.

8. Course and Prognosis.

Special attention has been given to prognosis during the past five years, probably because of the need for an accurate assessment of the newer forms of treatment. A number of workers have followed up cases treated before the introduction of shock therapies as a control group for present-day cases, and have attempted to assess the factors of prognostic significance :

Author.	Number of patients.	Percentage total remissions.	Length of time observed.
Blair (1940)	120	6	1–6 years
Cheney and Drewry (1938)	500	12	2–12 ,,
Kant (1941*a*, *b*, *c*)	308	6·62	7½–10 ,,
Malamud and Render (1939)	177	14	5 years or more
Guttmann, Mayer-Gross and Slater (1939)	188	21·5	3 years
Rennie (1939)	500	24·56	9–20 ,, (or death)
Rupp and Fletcher (1940)	608	6·6	5–10 ,,
Silverman (1941)	271	10	15 ,,
Stalker (1939)	129	12	1–6 ,,

The percentage of total remissions varies from 6–24·56 as shown in the above table. The discrepancy between results is probably accounted for by the difference in material, criteria of diagnosis, and definition of the term full remission.

Favourable Features.

1. *Acute Onset.*

The value of this factor as a good prognostic omen has been fully borne out by recent investigations. Rennie (1941) found in an exhaustive analysis of 100 recovered schizophrenics that in 71 of them symptoms had come on acutely.

2. *Short Duration of Symptoms.*

Rupp and Fletcher found in a study of 641 cases of schizophrenia that 37·5 per cent. of those with symptoms of less than six months' duration prior to hospitalization were improved, while only 15 per cent. of those with symptoms for two years or longer benefited. Similarly Guttmann, Mayer-Gross and Slater found a spontaneous recovery-rate of 35 per cent. in patients who had been ill for a year or less before hospitalization.

These figures are indicative of the findings of most workers, and it may be concluded that the duration of illness is a major consideration in arriving at a correct prognosis.

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3. *Good Prepsychotic Personality.*

Good adaptation to life especially in the spheres of work, social and sexual adjustment mean a well integrated personality likely to get over a psychotic breakdown. Inadequacy of reaction shown by withdrawal, compensatory day-dreaming and autistic thinking are unfavourable features.

Stalker, in emphasizing this factor, points out that analysis of reaction must not be confused with analysis of personality type, and that a schizoid type must not be equated with maladaptation without consideration of the facts of the individual case. He suggests that the conflicting views may be due to the degree to which the various writers have intermingled " reaction " and " personality." For instance Rennie found that 66 per cent. of his recoveries were of the schizoid type. Other workers like Kant and Malamud and Render found a predominance of the cyclothymic personality type among their recoveries, and regard a schizoid make-up as of poor prognostic significance.

4. *Presence of Precipitating Factors.*

Adequate precipitating factors are a hopeful feature, especially if they can be removed. Kant (1942*a*, *b*) studied the question of psychogenic precipitation in some detail. He found such factors in the history of 74 per cent. of his recovered cases, but in only 15 per cent. of those who did not get well. However, the precipitating factor was found to be of an objectively extraordinary nature in only a small proportion of cases. Factors of a chronic type were found to be about five times as frequent in the recovered as in the deteriorated group. Prolonged overstrain and external conflicts predominated in the recovered group, single events and endogenous conflicts in the deteriorated group. The assessment of this factor seems especially liable to subjective bias. A more objective causative factor is bodily illness, and it is generally agreed that its presence is in favour of recovery, e.g. Rennie found 35 per cent. of his recoveries showed somatic disturbances as opposed to 22 per cent. of an undifferentiated group.

5. *Atypical Reaction.*

A high proportion of the cases which do not readily fit into one of the diagnostic sub-types of schizophrenia have been noted among completely recovered cases by most workers. The atypical symptoms in this favourable group are usually of a manic-depressive type. That trends of this nature are favourable is shown by Kant. When he excluded all cases which showed a fairly close connection with the manic-depressive group his figures for the percentage of total remissions fell from 6·62 per cent. to 1·65 per cent. In fact, of cases which displayed purely schizophrenic features only 2, or 0·66 per cent., of his 308 cases recovered. The good prognosis of the atypical cases in 100 schizophrenics observed by Langfeldt (1939) led him to study these " schizophreniform " cases in greater detail. His material was 100 cases of psychoses admitted to the University Clinic, Oslo, during the years 1926–32, who at the end of observation were discharged with a diagnosis of " ? schizophrenia." In his opinion the practice of most hospitals of including this group with schizo-

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phrenia accounts for the very variable results of different workers. The cases were followed up from 6–12 years.

He found 32 completely cured, 25 improved and 43 unchanged or worse. On re-examination and review he considers that only one of the 32 cases could be called genuine schizophrenia, while out of 43 uncured cases 36 were typical schizophrenias.

His claim that these typical schizophrenias can be differentiated from the schizophreniform psychoses at an early stage in 90 per cent. of cases requires further substantiation. The diagnostic criteria on which he laid emphasis were pre-psychotic schizoid personality and the presence of schizophrenic process symptoms in a clear setting.

6. *The Presence of an Affective Response.*

Collins (1943), in a study of affect in schizophrenic reaction types, concludes that "patients where affect remained strong itself and in harmony with cognition and conation have a better chance of remission."

This point is also made by other workers, notably Rennie, who found that 63 per cent. of his recovered patients showed at some time during their illness a capacity for genuine affect. This does not refer to mere laughing or crying; "the laughter must be infectious or the expression of emotional pleasure, or the weeping must be accompanied by suitable facies and manner, sense of guilt or statement of depressive mood."

7. *Clouding of Consciousness.*

An element of clouding of consciousness in the clinical picture is a good sign. This is especially stressed by Kant (1941), who found that in 26 of his group of 39 recovered patients clouding of consciousness was an outstanding feature. In a comparable group of deteriorated patients it was found only three times.

8. *Heredity.*

An unexpected finding of most workers in recent years was that a positive family history of psychosis is not an unfavourable factor.

Rennie found that 53 of his 100 recovered cases had a family history of psychosis, of which 22·6 per cent. were schizophrenic and 41·5 per cent. affective psychosis. He contrasted this with a group of 500 unselected cases of schizophrenia which he followed up in a previous study, and found 40 per cent. with a family history of psychosis, of which only 9 per cent. were schizophrenics. He considered the difference significant, and offered in explanation that "these patients are more susceptible to the development of schizophrenia, which in itself is of less significance than a comparable development in a better organized personality."

Malamud and Render also emphasized the high percentage of negative histories in unimproved cases as compared with hereditary tainting in those who recovered. Kant confirmed these findings, but pointed out that the incidence of manic-depressive psychosis in his recovered patients was 4½ times

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greater than that of schizophrenia. Similarly Hutter (1941), who made a long term study of 229 cases, stated: "In general the outcome in those with demonstrable heredity was somewhat more favourable than in those with no evidence of hereditary taint." Conversely Blair, surveying earlier literature and following up 120 cases, concluded that a family history of schizophrenia renders the outlook dubious.

9. *Good Response to Sodium Amytal.*

An additional aid to prognosis has been suggested by Harris, Horwitz and Milch (1939) in the reaction of the patient to intravenous sodium amytal. Prenarcotic doses of the drug were given to 55 cases of schizophrenia. An ameliorating response was obtained in 30 patients, and of these 23 responded favourably to insulin therapy. No ameliorating response was obtained in 25 cases, and of these 16 failed to respond to insulin. Gottlieb and Hope (1941) also consider this a useful prognostic criterion. Of 100 cases which they observed 15 had shown good reactions to the drug, and all made either a complete or a social recovery. Of 61 patients who had shown poor reaction to sodium amytal 53 were unimproved. "The more closely the patient's behaviour approaches normal under the influence of the drug, the better the prognosis."

Features of Doubtful Significance.

(1) *Age.*—Rennie found that 40 per cent. of his recovered group broke down between 21–30 and considered this the most favourable age of onset, but Malamud and Render found a preponderance of the unimproved group among those whose illness began in the third decade. Other workers, e.g. Guttmann, Mayer-Gross and Slater, Rupp and Fletcher and Stalker, found no evidence of statistical significance with regard to the effect of age on prognosis.

(2) *Sex.*—Guttmann, Mayer-Gross and Slater found that the recovery-rate from first attack and subsequent relapse was greater in females and the relapse rate lower. Rennie supports this view, and found that 55 per cent. of his recoveries were women in his group of 500 cases.

On the other hand, neither Kant nor Stalker could find a definite trend in favour of either sex, and Malamud and Render found a slightly higher proportion of males among their recoveries.

3. *Body build.*—Attempts have been made to utilize Kretschmer's somatic types in the assessment of prognosis. Findings varied considerably, probably because of differing criteria used by individual observers.

Extremes are represented by Kant, who found pyknic physique in more than half his recovered cases, and Malamud and Render, who did not find one of this type in their completely recovered group. Gottlieb (1940), in a study of prognosis in hebephrenia, says: "Patients of pyknic and dysplastic habitus as a rule develop an atypical form of hebephrenic schizophrenia and show a tendency to improvement or recovery." Though it is not possible to be dogmatic, the general tendency is to consider athletic and pyknic builds as favourable factors, while dysplastic and asthenic types are against recovery.

(4) *Intelligence and education.*—Malamud and Render found a relatively

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high proportion of intelligence quotients over 105 in recovered patients, with a noticeable preponderance of "scatter" of five years or more in other groups. Rennie, on the other hand, divided his 100 recovered patients according to different educational levels, and found the highest percentage (38 per cent.) in the lowest scholastic category. He pointed out that a psychosis in a person of limited intelligence or poor education may be prognostically more favourable, because the illness itself is less alien than similar manifestations would be in a person of good intelligence and training.

Unfavourable Features.

In general these are the opposite qualities to those listed under the heading "Favourable Features." Besides this Chase and Silverman (1941), in a critical review of the literature on prognosis, state: "The presence of true process symptoms, especially in the absence of the element of confusion, is of the greatest significance." They quote Langfeldt's (1937) conception of process symptoms in schizophrenia:

(1) Massive catatonic stuporous symptoms.
(2) Depersonalization.
(3) Derealization.
(4) Massive sensations of influence.

It may be concluded that a high proportion of the following factors can be relied on to indicate a good prognosis: Recent acute onset of symptoms which do not easily fit into a diagnostic subtype, and show manic-depressive trends with well-retained affect in a person of previously good personality. If there is a family history of psychosis, especially of the affective type, if the symptoms appear on a background of clouding of consciousness, and if an adequate precipitating factor, psychogenic or somatic, can be found, so much the better. The age, sex, body type, or intelligence in the light of present knowledge cannot be relied on to give an accurate clue to the outcome. Of grave significance is a gradual onset over months or years without discernible cause in an inadequate individual, who displays little affect and evinces marked process symptoms in a clear setting.

9. Treatment.

Treatment by insulin, convulsions and prefrontal leucotomy is discussed in Chapters 25-27.

Following the favourable results obtained by the use of so-called shock therapies, efforts have been made to find a means of achieving the same results by a method less time-consuming than insulin and with fewer complications than convulsion therapy.

On the basis of the suggestion that the chief mechanism of improvement in these forms of therapy is cerebral anoxia, Alexander and Himwich (1939) treated 12 cases with nitrogen administered by a gaseous inhalation anaesthesia apparatus. By this means they claimed to produce a temporary depression of cerebral metabolism, and so avoided irreversible changes. Treatments were given three times weekly and as many as 46 were given in a course. They consider their results encouraging. Fogel and Gray (1940) report 24 cases

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treated by nitrous oxide inhalations using a similar technique. They obtained good results in early cases, but found chronic cases of more than two years' standing showed no change. It is claimed that these methods are safer (in the hands of a skilled anaesthetist), less objectionable to the patient and cheaper than insulin or convulsion therapy. Green and Adrian (1940) treated 17 schizophrenics with nitrogen inhalations, using the technique (slightly modified) advised by Alexander and Himwich. Their results were disappointing, and did not compare favourably with expectations on the basis of experience with insulin and metrazol in similar cases.

The temporary improvement in some schizophrenics noted after the administration of intravenous sodium amytal led Davidoff (1941) and others to give it over a prolonged period alternating with benzedrine, in order to depress and stimulate the central nervous system. On one day benzedrine (amphetamine sulphate) in doses of from 10–40 mgm. was given intravenously, and the following day sodium amytal 0·6–1 gm. by mouth, and this alternation was continued for periods up to two months. In 51 out of 80 schizophrenics reported the psychosis was of less than two years' duration, and of these, 22 were discharged to their homes much improved. In the remaining 29 with a psychosis of more than two years' standing 7 were discharged, giving a recovery-rate of 36 per cent. for the whole group.

Renzikoff (1941) applied the same technique in 15 schizophrenic patients without any evidence of deterioration, 10 being under one year's duration. The results were "uniformly disappointing." None of the patients showed any more improvement than other schizophrenics who did not receive any specific therapy.

At a time when purely physical methods of treatment are so much in the forefront, there is evidence in current literature that the necessity for less specific measures has not been forgotten. There is general agreement that patients improving under insulin or convulsion therapy or after leucotomy need individual attention, and every effort should be made to help them to maintain their contact with reality and to readjust themselves to life. Similarly the aim of the modern mental hospital is to prevent deterioration in chronic patients by individual attention and stimulation of interest through occupational and recreational therapy. Myerson (1939) has shown what can be done with these methods in chronic schizophrenics. Under the term "total push" he included such general measures as daily showers, massage and douches, exercise and games, which were specially devised to encourage the individual patient to take part. Food was made interesting and varied, clothing attractive, details of toilet carefully attended to and patients induced to take a pride in their appearance. A system of reward and punishment was used whereby privileges were given or withheld according to the patient's behaviour.

Corwin and Thompson (1939) reported on the use of similar methods, and state that of 26 patients of varying lengths of illness, at least half being chronic, 18 showed improvement. Such intensive measures require a large and highly skilled nursing staff, but it is at least a standard to aim at in the management of chronic cases, and some measure of it is an essential part of the specific

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treatments. In contrast to these disciplinary and educational methods, Schube and Cowell (1939) gave their patients complete freedom in the use of water colours, clay, pencils, etc., to give scope to creative abilities, and found that schizophrenics responded with increased activity.

To stimulate initiative and counteract the effect of hospitalization Bierer and Haldane (1941) tried the experiment of a patients' self-governing social club at Runwell Hospital. While difficulties can be foreseen in the successful functioning of such an organization, its potential benefit to schizophrenics would be considerable by encouraging a feeling of independence, freedom from discipline and a sense of responsibility.

The scheme described by Wootton and Minski (1940) for the rehabilitation and resocialization of patients is especially important for schizophrenics. The organization helped patients in the critical period immediately after discharge from hospital to obtain re-employment in their former vocations, and where this was impossible or undesirable, provided means of training them for more suitable work.

Practical suggestions for the organization of after-care for mental patients have been made in the Feversham Report, and already some of them have been carried out. Individual after-care along such lines is an essential part of the treatment of schizophrenics.

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DEPRESSION.

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MOST of the papers written on depression during the last five years have been concerned with matters which are dealt with by other contributors in this volume—its genetics, biochemistry, social aspects (including suicide), psychopathology, and treatment by endocrine preparations, electrical convulsions, and prefrontal leucotomy. The remaining papers, here briefly reviewed, are few in number, mainly clinical, and do not record any outstanding advances.

Several writers re-examined the features of depression occurring in later life. Doty (1942) studied a small group in whom the first attack of affective illness had occurred after the age of 40; contrary to the usual assumption he did not find that in these patients the affective picture was complicated by symptoms that could be accounted for by the patient's age. Inasmuch, however, as the bizarre preoccupations and somatic delusions familiar in severe melancholia were not present in his group, it may be supposed that his choice of cases depended on criteria which prevented the inclusion of instances of Cotard's syndrome, *Spätkatatonie*, and other manifestations of the age factor, whether associated with somatic pathological changes or not. In his group Doty found that the precipitating factors for depression were usually to be found in troubles in daily life, e.g., economic stress or bereavement, but that another important cause was reduced physical fitness, or the threat of this, due to some physical illness incident to advancing years.

Quite a different conclusion is reached by Malamud, Sands and Malamud (1941). Like Palmer and Sherman (1938), they consider that the involutional psychoses are a distinct reaction-type occurring in persons of a particular pre-psychotic personality, and representing a failure in adjustment to the problems specific to later life. Describing the pre-psychotic personality, they agree with Titley (1936) in emphasizing a rigidity and tendency towards restriction of interests. Some of the groups exhibited such combinations as (*a*) the hard-driving, aggressive, over-conscientious and stubborn, (*b*) the seclusive, autistic, under-active and prudish, (*c*) the sensitive, timid and hypochondriacal; seemingly a wide variety of personalities was in evidence. The same questions arise in the paper by Brew and Davidoff (1940). Malamud, Sands and Malamud found that precipitating factors sometimes appeared as catastrophic occurrences, threatening the patient's security or his continued possession of objects to which he was strongly attached. In evaluating the findings of these writers, it must be borne in mind that patients were not included as having involutional melancholia if a previous similar attack had occurred, though in a number of them there had been previous mental illness or personality disturbance (mainly

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regarded as neurotic reaction to a difficult situation). It is questionable whether it is safe to use, as these authors suggest, pre-psychotic personality to distinguish involutional psychoses from the recurrent variety of severe manic-depressive illness; informants are likely to have stressed the more recent personality traits which have become conspicuous during the last few years before the actual illness.

Obarrio (1939) has described three cases of recurring melancholic stupor, which would presumably not have been included by Doty in his group. Obarrio stresses the neurological interpretation of the stupor, on the lines of his earlier comparison with the extrapyramidal features of Parkinsonism. One of his patients had no less than ten stuporose episodes, and in all three patients the stupor invariably accompanied the depression, though periods of excitement or well-being might intervene between them. Obarrio does not consider the metabolic phenomena, which might have as important a role here as in some of Gjessing's cases, and he rejects a psychopathological interpretation in which the onset of stupor could be attributed to anxiety. His conclusion that there is adrenal insufficiency with extrapyramidal symptoms, attributed to lability of the locus niger, does not carry conviction. It is, however, undeniable that Parkinsonism of organic origin may be accompanied by severe melancholic symptoms, which cannot be regarded solely as a reaction to increasing awareness of reduced efficiency and bad health. An instance of this, secondary to carbon monoxide poisoning, is reported by Raskin and Mullaney (1940). Their patient died, and in the brain a typical pallidal lesion was found, with numerous small changes in the cortex. Hoffer (1940) provides a psycho-analytical study of depression in a patient with post-encephalitic disorder; he considers the depression essentially hysterical, and a reaction of the ego against organic deterioration. Another instance of the way in which organic disease of the brain can give rise to affective illness is given by Rothschild (1940); the patient had G.P.I.

Gustav Störring (1939), in his monograph on perplexity, insists that this symptom is most frequently to be found in the affective disorders which begin with severe anxiety, and he holds that this association occurs because delusional ideas of a self-accusing or persecutory kind, arising out of the anxiety, fade and leave the patients muddled and doubtful of the reality of what had so recently been a terrifying conviction. In other instances he accounts for the bewilderment by the suddenness of the transition between a depressive phase and manic excitement. Störring attributes the bewilderment in other cases to the patient's awareness of reduced capacity for clear thinking, which makes her doubtful about the continuity of her personality. He rightly emphasizes that the pronounced paranoid disorders of a depressive nature (so often mistakenly regarded as schizophrenic) are more often accompanied by perplexity than are acute paranoid schizophrenic conditions; here again, in the depressives, the fluctuations in affect determine fluctuations in the prominence of ideas of reference, and the patient is bewildered by the contrast between what he now believes and what he lately believed. Störring also mentions the perplexity common in the oneiroid syndrome so fully described by Mayer-Gross (1924).

Ernst Störring (1938), in a monograph on depersonalization in affective disorders, insists that depersonalized manic-depressives rarely present charac-

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teristic delusions of guilt; their restlessness and tension are expressed mainly in bodily terms. He takes a similar view to Gustav Störring, believing that the depersonalization occurs chiefly during transition, either from normal to depressive phase or from depressive to manic, or vice versa. All these views are questionable; from a study of his reported cases it seems that Störring has not sufficiently examined the close link between depersonalization on the one hand, and hypochondriasis, including somatic delusions and nihilistic beliefs, on the other.

Hohmann (1940) has reviewed the forms of depressive illness in which hypochondriasis constitutes the main presenting symptom. He adds little to the earlier study by Felix Brown (1936). He emphasizes that the depression is frequently masked, and therefore missed by the physician in his diligent search for physical disease or his ready acceptance of neurotic motivation. Hohmann goes so far as to conclude that "the overwhelming number of neurotic states are in reality mild or severe depressions which will run a course and terminate in recovery." Ziegler (1939) makes much the same point about masked depression; he analysed the records of 111 ambulant patients of all ages, who had first come to the surgeon or physician for the relief of seemingly bodily ailments, and who were subsequently observed by the psychiatrist and treated for depression as their chief symptom.

The view just stated in dogmatic form by Hohmann concerning the frequency of depression in so-called neurotic illness appears, or is controverted, in several papers tackling the vexed question of neurosis versus psychosis. Rogerson (1940) agrees broadly with Lange, Ross, Gillespie, Yellowlees and others who would classify all affective states in which anxiety or depression are predominant into the two groups, "neuroses" and "psychoses." Rogerson, however, recognizes that the affective states which he would call neurotic are frequently diagnosed as anxiety states, and that the question as to whether anxiety states should be differentiated from depressions has little substance, and must be reformulated if his standpoint be accepted.

An opposite view is taken by R. F. Tredgold (1941), who has examined carefully a number of soldiers diagnosed as "depression" in a military mental hospital. Tredgold found a number of individual patients who passed from an undoubtedly psychotic condition to one that would ordinarily be called neurotic, whereas other patients did the reverse; he regards this as supporting the view that the difference between the psychotic and the neurotic depressives is merely one of degree. Tredgold found that a quarter of all patients admitted to the military mental hospital were diagnosed as depression, but that they could not be sharply classified into clinical groups, any differences being of degree rather than kind. The course of the illness in his patients was satisfactory, except in those who were severely agitated; 84 per cent. of all the depressive cases recovered. Similar views are put forward by Curran and Mallinson (1941). They found that during the latter part of 1940, depressive states accounted for 13 per cent. of all admissions to a naval neuro-psychiatric unit. In an analysis of 99 consecutive cases they found no support for the view that there is any clear-cut division into endogenous and reactive, or into neurotic and psychotic groups. They would, however, distinguish between affective disorders, and hysterical reactions in which depression or anxiety may be

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conspicuous. Since hysterical and affective symptoms may co-exist, Curran and Mallinson would advocate assessing their relative intensity, in order that treatment appropriate to an affective disorder should not be applied to a patient in whom the hysterical symptoms are the most important or disabling, and conversely. Among their cases were men of a fine type and excellent morale, though deficient in adaptability, who as a result of prolonged stress developed depressive reactions which differed from those familiar in civilian life in that they responded more rapidly and satisfactorily to treatment. Thus 29 per cent. of their patients were able to return to naval duty, and only 6 per cent. needed further hospital care. Tredgold could not, among his soldiers, relate the form of the depression to particular experiences, and therefore believes that he is at variance with some statements of Curran and Mallinson, but since the latter authors were making only a provisional rough classification into which this consideration entered, it does not seem that there is any genuine divergence between their view and that of Tredgold.

A Dutch writer, Harrter (1939), proposes an extremely elaborate classification of depressive states; it is almost a *reductio ad absurdum* of the principle that they must be subdivided. There are seven main subdivisions of depression, and a still more minute analysis of these. Thus depressive syndromes associated with schizophrenic symptoms are listed as melancholia, minor depression, compulsive depression, hysterical depression and combined hysterical and obsessional depression, all of them occurring as symptoms of fundamental schizophrenia. Harrter's finespun classification shows how pointless diagnostic casuistry can be.

Kirchhof has recently analysed 1,955 new cases seen in the Neuro-Psychiatric Poliklinik at the Charité in Berlin during the 12 months between September, 1939, and September, 1940. Nearly a fifth of the cases (347) were diagnosed as showing a depressive state. Of these 203 were classified as endogenous, including a number of involutional cases. 69 were secondary to cerebral arterio-sclerosis, hypertension or cerebral atrophy; 44 were mainly reactive; 21 were of the cyclothymic type. Kirchhof puts great weight on the vasomotor disturbances, which he found in a quarter of the endogenous cases. The factors chiefly responsible for the reactive depressions were domestic difficulties, and stresses which the war had brought in its train, such as night duty, work under painful conditions, e.g. in factories among disagreeable smells or the noise of machinery, homesickness, and industrial inadequacy.

The association of skin disease with depression has been reported by Mari (1939). His patient was a woman of 30, who developed dyschromia in the course of a fairly severe depressive illness. The cutaneous changes persisted after the depression had subsided. In a lengthy discussion he maintains that endocrine factors were responsible. He does not pay enough attention to the possible nutritional factors. Laignel-Lavastine and Paugam (1939) report the association of psoriasis with depression in a man who, at the age of 38, first developed psoriasis. This improved considerably when, two years later, his first attack of depression came on. Similarly, in an attack of depression which he had five years after the first attack, the psoriasis fell into the background, but reappeared on his recovery from the depression one year later.

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Slater (1938) investigated the time of year at which affective attacks of the manic-depressive kind can occur, and confirmed the statement of Kollibay-Uter (1921) that the point of greatest frequency is early summer, and that there is a small secondary rise in early autumn. Tomasi (1939) analysed 313 cases, and similarly found a maximum of depressive states occurring in the spring and a minimum in winter. This corresponds to many studies that have been published regarding the incidence of suicide. Leuthold (1940), however, has examined the manic-depressives admitted to the Munich Clinic between 1930 and 1935, and finds that the increase in the onset of depression in October is greater than that which occurs in spring.

Fox (1942) selected 400 persons admitted to the Henry Phipps Clinic, Johns Hopkins Hospital, with manic-depressive or allied affective states, for an analysis of the leading dynamic factors. The patients had a fairly definite attack of pathological over-activity or under-activity more or less independent of immediate external influences. It was found that there were very few patients in whom the manic-depressive constitutional tendency was the sole factor, and there were only 83 who had a history of an attack of excitement. The constitutional or "thymopathic" factor proved to be intimately related to the personality structure and trends of preoccupation in the patients; it was particularly closely related to the tendency towards projection. A third of the thymopathic cases had one or more relatives with a history of excitement or depression, which was not an appreciably higher proportion than in the rest of the cases. The author emphasizes that these are remarkable findings, inasmuch as a large number of the 400 cases were such as would be put in the neurotic category in many clinics, e.g. there were many patients in whom anxiety was conspicuous. The pyknic habit of body was slightly less frequent in the primarily thymopathic groups than amongst the rest of the patients. Of all the patients, 98 had made suicidal attempts, but only 12 of these belonged to the thymopathic group. A higher proportion of the thymopathic cases had, however, a history of previous affective swings. A slightly higher proportion of thymopathic cases was discharged improved than of the remainder. From these findings the conclusion emerges that the so-called manic-depressive constitutional tendency is only one among a number of dynamic factors producing affective mental illness, and that it is misleading to regard this particular kind of affective response as a self-limiting attack in which only the hereditary or constitutional determinant is decisive. The foregoing study should be related to a follow-up inquiry by Rennie and Fowler (1942) into 208 patients with manic-depressive illness first seen between 1913 and 1916. They found that the hereditary factor, which is common in this group, was usually evident in the direct ascendants, and most frequently showed itself as a depression. Remission for as long as 10 to 20 years occurred in a third of the patients, and in 5 per cent. depression first appeared after the age of 65, though the largest incidence was in the age-group 45 to 55. All but 7 per cent. of patients recovered from the first affective attack, and only 7 per cent. of cases became chronic. On the other hand, less than a quarter of the patients had only one attack during the course of their lives. It is only by a follow-up carried out at such a distance of time as Rennie and Fowler's that one can see

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how unsafe it is to assume that the patient will be free from further trouble, even though several years have passed since recovery from the attack. Depression, they find, is more common in affective disorder than customary statistics would indicate. Manic patients sometimes commit suicide, and depressive or paranoid symptoms may be found on close investigation in three-quarters of the manic cases. The paper contains a great many points valuable in prognosis, and should be read in conjunction with comparable figures given by Kraepelin and Lange.

An interesting review of affective disorders among university students is provided by Himler and Raphael (1942). In two-thirds of the men and three-quarters of the women students the first attack occurring during their studies was a depressive one. In 60 per cent. of the students prompt psychiatric treatment enabled them to complete the academic term. The writers emphasize the danger that arises through the physician assuming that affective disorder of this kind is of psychoneurotic nature merely because some of the symptoms complained of, e.g. anxiety, or fatigability, suggest this on superficial inquiry.

Brill (1939) reports with psycho-analytical comments a patient in whom in his opinion actual suicide was effected by psychological means. He considers that the same forces that lead to ordinary suicide can impel some people to die without the need of resorting to any physical means of bringing this about. After quoting some of the extensive data in anthropological literature, he gives the history of his patient, who had put off going into a sanatorium when advised to do so. The melancholic symptoms were concealed, and eventually she died, largely because of her own failure to take sensible measures. He concludes that her object-love " had gradually changed into narcissistic identification," which in turn gave full play to already existing ambivalence towards her husband, with resulting liberation of her repressed sadism towards him. These hostile feelings finally annihilated (through what was tantamount to suicide) that object through which she had suffered humiliation and poverty.

Psychologists have reported findings, in depression, elicited by such methods as the Rorschach projection test, the use of a questionnaire and study of handwriting. J. S. Lewinsohn (1940), leaning heavily on Heinen's (1928) earlier work on handwriting in manic-depressive insanity and on Klages' (1936) well-known exposition, points out that in all psychotic handwriting the rhythm is completely disturbed in respect of height, breadth and depth ; the disturbance may, rather paradoxically, appear as rigid regularity. Tempo is also affected. In apathetic depression she finds slight irregularity, little difference between long and short letters, upper signs set low, more bond than release between letters, extreme slowness, but regular distribution. In agitated depression there is much more irregularity, fluctuation in the relationship between bond and release, acceleration of movements without emphasis, and distribution is irregular. Her analysis is too technical to be suitable for summary presentation. Varvel (1941) has examined by the Rorschach ink-blot method 34 depressed patients (7 of them classified as manic-depressive, 13 as reactive and neurotic, 14 as agitated or schizophrenic types of depression), and has compared them with 144 normal students. His results are somewhat inconclusive, and

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turn a good deal on the so-called constriction of personality. His evidence shows that it is impossible to distinguish constriction which is part of the pre-morbid personality, from constriction manifesting itself in the course of the depressive illness. Constriction can, of course, be found in socially adjusted "normal" individuals, in which case Varvel regards it as a fundamental characterological deviation.

Hathaway and McKinley (1940) have described a scale to measure various clinically important phases of personality. 3,000 normal and abnormal individuals have now been tested and their answers to the 504 items in the schedule classified. The normal group was derived from visitors and relatives of patients in the University Hospital. In a study of hypochondriasis it was shown that the scale yielded a score from which the degree of hypochondriasis could be inferred. Fifty carefully chosen depressed patients were compared, in another study, with 339 normal adults between ages of 26 and 43, 265 college students, 40 normal persons who appeared to have a high depression score on a preliminary application of the procedure, and 50 patients who had similarly scored high on the scale but did not show clinically observed depression. The preliminary scale referred to contained 70 items which were left after the scale had been purged of all items that seemed unreliable. For clinical use raw scores from the schedule were transferred into standard scores in which the means of each of the whole normal groups of males and females between the ages of 16 and 45 were given the value of 50; other raw scores were transformed so that the standard deviation would be 10. A significant separation of clinically depressed patients from normal could be demonstrated for a large percentage of cases, and patients who had moderate degrees of depression without any specific abnormality could also be differentiated. The scores were significantly higher for females than for males, and they become higher with increasing age. It is doubtful whether the method is of much value, since it consists, at bottom, of asking the patient whether he has any of the familiar symptoms of depression. It would presumably fail to detect such a patient at a time when he was free from depression or resolved to conceal it, and it is open to the criticism that a questionnaire method, used on depressed patients, is less satisfactory than a clinical interview in indicating the severity of their depression.

Rennie and Howard (1942) believe that the clinical syndrome of "tension-depression" can be related to hypoglycaemia, the latter being symptomatic of the emotional disorder. They emphasize that changes in blood sugar may not in themselves lead to any discomfort, and that there is great variation between individuals in this respect; the treatment of patients exhibiting such a condition of depression with hypoglycaemia must therefore be psychiatric rather than chemical.

Strongin and Hinsie (1939) had described in 1938 their observations on the secretory rate of the parotid gland, showing that it was lower in "manic-depressive depression" than it ever became in normal persons. In 1939 they published data designed to show whether there is here a difference between depression of the mainly endogenous recurrent kind and other varieties of depression. In 23 out of 25 patients with the former diagnosis the parotid

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secretory rate was below an average of 0·01 c.c. per 5 minutes during a test of half an hour's duration. In 24 out of 25 with " non manic-depressive depression " the parotid secretory rate was still level. They also found that the parotid secretory rate was inhibited in early stages of the manic-depressive disorder, before clinical diagnosis was possible. The inhibition prevails during the daily mood fluctuations of the patient, but the rate returns to normal when the patient recovers from his depression ; the rise when he improves may be very sudden. Inasmuch as parotid secretion is controlled by the autonomic nervous system, it would be desirable to know the findings in a large group of patients with anxiety states or " tension depression " before assuming that sharp differentiation can always be made by means of the test.

The body temperature in various forms of mental illness varies more widely than is sometimes recognized. H. I. Schou (1940) has studied ten patients with affective disorder, and found that the temperature of the skin of the temples was low during the depressive phase, whereas that of the hands and feet was high. In four patients who recovered after fits had been induced by cardiazol, the foot temperature sank to normal immediately after recovery ; the temperature of the temples rose, but not to the same extent as the foot temperature fell. Schou advocates that any abnormality of the skin temperature in a depressed patient who is recovering should be taken as a sign that the illness is not yet really over.

Looney *et al.* (1939) made exact inquiries into the possibility that the phytotoxic index was abnormal in depressives. The results were negative, and this ingenious method of investigation, on which a paper had already been published in Scandinavia, appears unlikely to be pursued further.

Discussion of most of the papers dealing with the treatment of depression will be found under the sections on convulsion therapy, endocrines, vitamins, psychotherapy and prefrontal leucotomy. A few scattered papers in which other, rather feeble methods are reported may be mentioned here.

H. Sopp (1939) treated 32 depressives of various sorts with " decholin " and vitamin B. The decholin (a 20 per cent. watery solution of sodium dehydrocholate) was introduced by De Crinis a decade ago for the treatment of melancholia. Ten c.c. of the decholin are injected intravenously for four days, vitamin B1 being also given alternately intravenously and subcutaneously. After the first four days the same dose was given every second day up to 10 injections, and if the patients improved, thereafter once or twice a week. Of 32 patients, 8 recovered completely, 16 improved to some degree, 8 were unchanged ; of the 8 who recovered completely, 3 were mainly reactive, 2 were involutional, 2 climacteric, 1 mainly endogenous. Sopp states that the possibility of recovery being independent of treatment could be excluded. Following Roggenbau (1936), he considers that the liver is at fault in these cases, but his evidence is very slender.

There are a few papers dealing with the treatment of depression by haematoporphyrin, according to the method first advocated rather more than ten years ago by Hühnerfeld (1932). O. Bruel (1939), writing from Denmark, describes how he obtained recovery in 50 per cent. of a small group of private out-patients with depression ; in several others improvement was brought about. He

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holds that it is an almost specific remedy in patients who exhibit pyknic constitution with cyclothymic traits. Bruel has not observed any untoward or even disagreeable effects in any of his cases. This is somewhat surprising, as the injection sometimes leads to considerable discomfort. H. Schaeffer (1939) intimates that the method has had some vogue in France also. Schaeffer recognizes that the reports already published are contradictory; the value of the method is in doubt.

A few German articles on pervitin treatment of depression have been published; its action is similar to that of benzedrine. Dub and Lurie (1939) gave benzedrine twice a day to a number of severely depressed patients, increasing the dose if there was no improvement after one week. Control methods were employed to judge the efficacy of the benzedrine. The diagnoses in the 48 women treated were too varied, however, for safe conclusions to be possible regarding the value of the method, though the authors draw favourable conclusions. Finkelman and Haffron (1939) treated 15 severely depressed patients with large daily doses of benzedrine for a period varying from 3 to 13 weeks. Few of the patients improved, and in those who did the result could not be attributed to the benzedrine, except in one instance. In several patients the benzedrine made them more restless and irritable, or even suicidal. These conclusions do not invalidate the usefulness of the drug for some forms of mild depression. Chittick and Myerson (1941) have also reported results of benzedrine treatment of depression.

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PSYCHOPATHIC PERSONALITY.

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"I can't define an elephant; but I know one when I see one."

THE discussion of any topic is handicapped so long as there are doubts and disagreement as to what is being discussed.

There is general agreement that a large and heterogeneous mass of abnormal and unusual people do exist who are not suffering from any of the more formally recognized types of mental disorder. There is also agreement that the study of such people is of great social and psychiatric importance. There is not, however, the same agreement as to how these abnormal and unusual people should be classified, nor as to the terminology that should be used for this purpose. At various times such terms as moral insanity, moral imbecility, temperamental instability, psychopathic inferiority, constitutional psychopathic inferiority, constitutional psychopathic state, psychopathic personality, psychopathic state and even neurotic character have been proposed to describe varying sections of the group.

In order, perhaps, to avoid any suggestion of a moral judgment or an unproven theory of aetiology, such terms as moral imbecility and constitutional psychopathic inferiority have become less popular, and the more neutral term of psychopathic personality is at present widely favoured. Thus, for example, "the term psychopathic personality has come into more general and official use, but there is no term used in this connection that could not be criticised with more or less reason" (Hall, 1941).

An extension in the direction of disarming neutrality can be seen in the advocacy of the term psychopathic state by Henderson (1939); but perhaps this term, like psychopathic personality, owes its merit to a frank confession of ignorance, and may in time be replaced by more satisfying categories defined on an aetiological basis.

A further source of difficulty has been lack of agreement upon the precise meaning of the term "psychopathic," for it is employed both in the general and literal sense of "deviation from the normal in all possible directions and mixtures" (Bleuler, 1936), and in the more special sense of exemplifying the suggested characteristics of the behaviour of a psychopathic personality, however this may be defined or described.

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Definition.

The following definitions, drawn from the voluminous literature on the subject, may serve as a starting-point for discussion.

Kahn (1931): "It is impossible to give an exact definition of psychopathic personality. By psychopathic personalities we understand those discordant personalities which, on the causal side, are characterized by quantitative peculiarities in the impulse, temperament and character strata and in their unified goal-striving activity are impaired by quantitative deviations in the ego and foreign variations."

Schneider (1934): "Psychopathic personalities are those abnormal personalities who suffer from their abnormality or from whose abnormality society suffers."

White (1935): "Psychopathic as a prefix has come to be a wastebasket into which all sorts of things have been thrown. Society has developed machinery—more or less ponderous and creaking and ineffective to be sure, but nevertheless based upon fairly concrete formulations—for handling the so-called insane at one end and the so-called criminal at the other. The psychopaths fall between. They belong in neither group, and they get into either more or less by accident."

Henderson (1939): "The exact term we use is perhaps not very material so long as we define what exactly we mean, but personally I prefer to use the term psychopathic state because it does not stress unduly either innate or acquired characteristics, and does not imply total mental unsoundness, defect or delinquency, but yet allows for modifications of all of them . . . it is the name we apply to those individuals who conform to a certain intellectual standard, sometimes high, sometimes approaching the realm of defect but yet not amounting to it, who throughout their lives, or from a comparatively early age, have exhibited disorders of conduct of an anti-social or asocial nature, usually of a recurrent or episodic type, which, in many instances, have proved difficult to influence by methods of social, penal and medical care and treatment, and for whom we have no adequate provision of a preventative or curative nature. The inadequacy or deviation or failure to adjust to ordinary social life is not a mere wilfulness or badness which can be threatened or thrashed out of the individual, but constitutes a true illness for which we have no specific explanation."

Savitt (1940), after reviewing some thirty definitions, advocates that of Cheney (1934): "Psychopathic personalities are characterized largely by emotional immaturity or childishness with marked defects of judgment and without evidence of learning by experience. They are prone to impulsive reactions without consideration of others, and to emotional instability with rapid swings from elation to depression, often apparently for trivial causes. Special features in individual psychopaths are prominent criminal traits, moral deficiency, vagabondage and sexual perversion. Intelligence shown by standard intelligence tests may be normal or superior, but on the other hand, not infrequently a border-line intelligence may be present."

North (1940): "We are inclined to look upon the psychopathic personality as a type of personality expressed in behaviour which is definitely out of step

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with the individual's situation in life (or in the group in which he lives). The outstanding characteristics are that the behaviour is abnormal, non-constructive, not always useful to the individual, and that it leads to maladjustment and may be harmful to society."

Levine (1940): "It is essentially that the psychopath has a different set of solutions from the neurotic, in which the psychopath tends to make others unhappy and the neurotic to make himself unhappy." And again—

Levine (1942): "The patients of this group do not have specific signs and symptoms of illness as do the neurotic and psychotic. Their disturbance is one of action and social behaviour. The essential patterns of the psychopath are these. They live predominantly in short term values, i.e. have a predominant need for the immediate satisfaction of their impulses and desires, and are unable to subordinate immediate gratifications for more lasting pleasures. They tend to act out their conflicts in social life, instead of developing symptoms of conflict in themselves."

In March, 1941, a vigorous discussion took place at a joint meeting of the New York Neurological Society and the Section of Neurology and Psychiatry of the New York Academy of Medicine on the definition and limitation of the psychopathic group. At this meeting A. A. Brill expressed the view that "all the psychopathic personalities belong to some psychotic group and should be classified accordingly."

Somewhat similar views have been expressed by Cleckley (1941): "In the wide spectrum of personality functioning he (the psychopath) lies, let us say, not in the extensive and variegated borderland between psychosis and the normal, not among or near the various and bewildering shades of psychoneurosis, but plainly and unquestionably within the vivid area of the psychotic."

Petrie (1942) pleaded that merely abnormal or prepsychotic personalities, e.g. those showing cyclothymic or schizoid features, should not be labelled psychopathic, as this would tend to over-extend an already vague and indeterminate group, and K. A. Menninger (1941) has expressed similar views.

Again, according to Bullard (1941): "The commonly accepted conception of a psychopath is a person who cannot learn by experience, who fails to recognize the limiting or restraining influence of reality. Such a person recognizes no law but his own immediate need . . . the history of the psychopath is replete with a succession of misadventures. They are truly the social misfits. . . . It is in fact a very far cry from the schizoid and related people, who are often highly valuable if somewhat unstable members of the community, through the cyclothymics, who often carry on useful lives in the most conventional manner between their phases of disturbance, to the psychopaths, who by no stretch of the imagination can be conceived to be useful citizens. They live in and for the moment, have a keen intuitive empathy which enables them to shift position rapidly, but they have no real alertness to or comprehension of the implications or complications resulting from their behaviour." Bullard stresses the importance of a poor work record as a clue to the diagnosis.

Goldstein (1942) makes the same point when discussing the exclusion of psychopaths from the armed forces at recruiting boards: "Psychopathic

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personalities were recognized by the response to questions as to jail and school records."

It must be confessed that no very clear or unitary conception of what constitutes the psychopathic personality springs to life from these definitions; yet many of them share in common an emphasis upon episodic and impulsive behaviour which is socially undesirable, this episodic and impulsive behaviour being recurrent and, in the present state of knowledge, unmodifiable. The salient feature of the psychopathic personality is stressed as essentially consisting in persistent or repeated disorder of *conduct* of an anti-social type.

Classification.

A more complex, confusing picture emerges from the study of the various classifications of psychopathic personality that have been proposed.

Kraepelin (1915): The excitable, the unstable, the impulsive, the eccentric, the liars and swindlers, the anti-social, the quarrelsome.

Partridge (1930): Inadequate—(*a*) insecure, (*b*) depressive, (*c*) weak-willed, (*d*) asthenic; egocentric—(*a*) contentious, (*b*) paranoid, (*c*) explosive, (*d*) excitable, (*e*) aggressive; criminal—(*a*) liars, (*b*) swindlers, (*c*) vagabonds, (*d*) sexual perverts.

Kahn (1931): The nervous, the anxious, the sensitive, the compulsive, the excitable, the hyperthymic, the depressive, the moody, the affectively cold, the weak-willed, the impulsive, the sexually perverse, the hysterical, the fantastic, the cranks, the eccentric.

Schneider (1934): The hyperthymic psychopaths, the depressive psychopaths, the self-insecure psychopaths, the fanatics, the attention-seeking psychopaths, temperamentally unstable psychopaths, explosive psychopaths, insensitive or antisocial types, weak-willed psychopaths, asthenic psychopaths.

Strecker and Ebaugh (1935): The criminal, the emotionally unstable, the inadequate, paranoid personalities, drug-addicts, pathologic liars, swindlers, kleptomaniacs, pyromaniacs, the morally degenerate, sexual psychopaths, the hobo, the pseudo-querulant, the malingerers.

Noyes (1935): The excitable, the inadequate, pathological liars and swindlers, the anti-social, sexual psychopaths.

Sadler (1936): Kleptomaniacs, pathologic liars, eccentrics, sex abnormalities, the feebly inhibited.

Bleuler (1936): Nervosity, the aberrations of the sexual impulse, abnormal irritability, instability, special impulses (squanderers, wanderers, gambling mania), the eccentric, pseudologia phantastica, constitutional ethical aberrations (enemies of society, moral imbeciles), the contentious.

Henderson (1939): The predominantly aggressive, the predominantly passive or inadequate, the predominantly creative.

K. A. Menninger (1941): The predatory personality, the sycophantic personality, the histrionic personality, the façade personality, the transilient personality.*

* To anticipate possible research: "Leaping or passing from one thing or condition to another" (O.E.D.), or, in other words, our old friend the grasshopper mind.

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Levine (1942): The alcoholics, the drug addicts, the sexual deviates or perverts, the hysterical psychopathic personalities, the pugnacious or overly aggressive individuals, the inhibited or shy individuals, the individuals showing other types of neurotic behaviour, some criminals, viz. psychopathic criminals.

U.S. Navy, quoted by Griswold (1942): Inferiority without psychosis, emotional instability, criminalism, inadequate personality, paranoid personality, pathologic lying, sexual psychopathy.

The classification of the American Psychiatric Association :—

Psychopathic personality :

With pathologic sexuality—indicate symptomatic manifestations, e.g. homosexuality, erotomania, sexual perversion, sexual immaturity.

With pathologic emotionality—indicate symptomatic manifestations, e.g. schizoid personality, cyclothymic personality, paranoid personality, emotional instability.

With asocial or amoral trends—indicate symptomatic manifestations, e.g. antisociality, pathological mendacity, moral deficiency, vagabondage, misanthropy.

A perusal of these lists cannot fail to suggest that the conception of what can constitute a psychopathic personality has undergone considerable extension. It will be recalled that the central conception deduced from the proposed definitions which have been considered lay in persistent or repeated disorder of conduct of an anti-social kind. Whilst many of the "types" listed are clearly anti-social, other types are outlined according to their predominant mood or some leading attribute of character who are not obviously or even probably anti-social at all. Indeed no central conception of any kind other than the probability of some degree of "abnormality" can readily be deduced from these lists. The one deduction, however, which does seem to be legitimate is that if a classification is erected on the basis of a leading characteristic, as appears to have been done, this characteristic will be shown persistently; or, in other words, that the central feature of psychopathic personality is some degree of persistent abnormality of character which is frequently (but not necessarily) anti-social in its manifestation.

The Criteria of Psychopathy.

As a consequence of the realization of the limitations of a descriptive approach, attempts have been made to seek the basic components of psychopathic personality.

Levine (1940): Not normal, i.e. not mature, of good health and adjustment; not psychotic; not neurotic (although they may develop neurotic or psychotic symptoms); not necessarily feeble-minded; they live in a greater degree than is healthy in terms of short term values or the pleasure principle; they tend to solve their life conflicts by overt behaviour.

Hall (1941): Egocentricity; inability to profit by experience; emotional instability; lack of perseverance; unreliability and irresponsibility; defective judgment; suspiciousness.

Sprague (1941): Inability to postpone; ineffective consideration of consequences; insufficient learning from experience; faulty synthesis; dispro-

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portionate responsiveness; affective dominance over intellect; disvaluation of reality; disregard for truth; insufficient social valuation.

Cleckley (1941): Superficial attractiveness, cleverness, facility in talking and often apparently good intelligence; freedom from psychotic and more marked psychoneurotic symptoms; unreliability and irresponsibility; disregard for truth and honesty; unwillingness sincerely to accept any blame; absence of shame; cheating; lying, thieving often for trivial gains; poor judgment concerning his own welfare; inability to learn by experience; egocentricity; poverty of affect; inability to see himself as others see him; inadequate responsiveness to special consideration or kindness; shocking or fantastic episodes of behaviour often associated with a drinking bout; infrequent sincere suicidal attempts; tendency to create scenes and situations so bizarre and untimely as to seem purposeless; sexual abnormalities, e.g. promiscuity; the manifestations of psychopathic behaviour may begin at any time, not necessarily in childhood; lack of perseverance; repeated failures to make good.

The criteria offered by each author can of course only relate to that group which the author in question is willing to recognize; and although it will have become evident that no general agreement has been reached on this point, yet it is not perhaps without significance that all these four authors who have made the definite attempt to list criteria agree in outlining an unreliable type of individual of defective judgment, liable to impulsive acts which are often both imprudent and inconsiderate, and who is moreover unable to profit by experience.

Aetiology.

The research into the aetiology of psychopathic personality has been directed towards the elucidation of constitutional, physical and environmental (including psychological) factors.

(1) *Constitutional factors.*—Many authors have emphasized their belief in the consitutional origin of these cases. Thus, North (1940) holds that the failure of treatment points to a constitutional cause, and according to Slater* (1938), "with few exceptions, however, the psychopathic personality is the result of the combination of hereditarily determined tendencies." Slater, in this authoritative review, goes on to add that normal or superior personalities are similarly determined by inherited tendencies.

These views appear to represent the most commonly held opinions. On the other hand, Cleckley (1941) remains "skeptical" about the significance of a positive family history in a psychopath, as in his cases "familial inferiority is notably lacking." As he points out, however, he is only concerned with a strictly limited group.

Hopes that exist in this sphere have been summarized by Henderson (1942): "The science of genetics, still in its infancy, may contribute much to our knowledge, and we can look forward with confidence to the greater information to be derived from the study of uniovular twins, and to the benefit likely to follow such a positive eugenic step as the adoption of family allowances."

* A most valuable contribution by this author has appeared too recently for inclusion in this survey (*J. Neur. and Psychiatry*, **6**, Nos. 1 and 2, Jan.–April, 1943).

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More precise genetic studies have been mainly concerned not so much with psychopathic personalities defined as such as with abnormalities of character associated with other forms of mental illness. A study of Riedel (1937) revealed a heavy loading of abnormality of various kinds, including criminal, defective, schizophrenic, as well as unusual ("auffallende") personalities but no evidence of genetic unity. Again Wildermuth (1937) records a probably uniovular pair of female twins who were both severe hysterical psychopaths. It is, however, only by an extension of the concept of psychopathy to cover almost the whole field of psychiatry that, for example, the studies by Lewis (1935) on obsessional states, by Kolle (1931) on paranoid states, by Brugger (1934) on alcoholics or by Davidenkov (1936) on epileptics could be considered here. For the same reason no attempt could be made to summarize the large literature on the heredity of criminals and delinquents, amongst which a well known book by Lange (1929) and the work of Rosanoff, Handy and Rosanoff (1934) are outstanding examples of the approach through the study of twins.

So long as there is no consensus of opinion as to what constitutes a psychopathic personality, there can be no clearly defined clinical entity from which genetic studies can readily make a start.

Confirmatory evidence as to the constitutional origin of these cases has been deduced from the study of the electrical activity of the cortex.

These studies "stem" from the work of Davis and Davis (1936), Lowenbach (1939) and Lennox, Gibbs and Gibbs (1940), who found that cortical dysryhthmias of an epileptoid type may frequently be seen in the EEGs of unaffected relatives of epileptics. Williams (1941) concluded: "An abnormal EEG in an otherwise normal subject is strong evidence of an inborn constitutional abnormality involving the central nervous system. This abnormality appears to be non-specific, and may manifest itself in the subject or his offspring as a behaviour disturbance which may be psychoneurotic, psychopathic, psychotic or epileptic in type."

Gallagher, Gibbs and Gibbs (1942) studied 200 boys, 14–15 years old, with special reference to any relationship between the EEG and personality deviations. They found that there was no rigid relationship between the EEG and personality, but that if the EEG fell within certain normal limits, the chances that the personality would be normal were increased, whilst if it departed widely from the normal, the chances of an abnormal personality were increased. The deviations of the EEG were often, however, identical in poor and good personalities; but in general, an unusually slow cortical activity was more likely to be associated with a poor personality, and an unusually fast cortical activity with a good personality.

In a valuable paper Hill and Watterson (1942) concluded: "It is with aggressiveness that the EEG shows the consistent abnormality. The more aggressive the patient, the more likely is the EEG to be abnormal. On the evidence gathered by us from control material and patients, and that obtained by other workers, one can have little doubt that an abnormal EEG constitutes for its possessor a handicap in the business of biological adaptation, failure of which may show itself, as in our present series, in undesirable social behaviour."

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Hill and Watterson provide a table summarizing the results of their own work and that of Williams (q.v.):

Category.	Abnormal EEG.
Highly selected flying personnel . .	5 per cent. (Williams).
R.A.M.C. personnel	10 ,, (,,).
Mixed controls	15 ,, (Hill and Watterson).
Mixed psychoneurotics . . .	26 ,, (Williams).
Inadequate psychopaths . . .	32 ,, Hill and Watterson).
Aggressive psychopaths . . .	65 ,, (,, ,,).

Hill and Watterson also state that there is some evidence that the changes seen in the EEGs of epileptics are associated with the changes in the pH of the fluid interchange through the cell membrane. On this basis they are investigating the question as to whether the brains of aggressive psychopaths also show this defect of acid base balance control. They state that three factors are known to influence cortical rhythms. (1) Biochemical changes in the blood (hypoglycaemia, oxygen lack, toxic encephalitis). (2) Cerebral trauma, either at birth or subsequently. (None of the abnormalities found in the series investigated could not have been produced by trauma. In the aggressive psychopathic group, however, a history of head-injury was less common among those with abnormal EEGs than among those with normal ones. This is a somewhat surprising result in view of the well-known fact that head injury can result in aggressive behaviour.) (3) Constitutional defects (Lennox, Gibbs and Gibbs, 1940).

Hill and Watterson favour the idea of " cortical immaturity " on the basis of the similarity between the EEGs of aggressive psychopaths and those of young children. In this connection it is intersting that Brill and Seidemann (1941) found a diminishing incidence of slow rhythms with advancing adolescence. Somewhat similarly Secunda and Finley (1942) found that abnormal EEGs were more common amongst problem children than amongst normal children, but the cases of behaviour disorder showed abnormal EEGs with a diminishing frequency as they grew older. Thus, in the 4–9 age-group the frequency of abnormal EEGs was 74 per cent., and in the 16–18 age-group 34 per cent.

Curran and Guttmann (1943) conclude a brief discussion of this subject as follows: " It is perhaps worth mentioning that bodily anomalies frequently co-exist with the psychological anomalies in these abnormal characters, and all the so-called nervous symptoms, such as tremor, restlessness, profuse sweating, vasomotor lability with blushing and fainting and an allergic disposition are frequently found combined with the psychopathic anomalies, though detailed correlations have yet to be made. The same is true as regards morphological anomalies, often called stigmata, asthenic build, disproportion in physique, underdevelopment of the secondary sexual characters, or heterosexual features."

(2) *Physical factors.*—Langfeldt (1938) pointed out that the number of cases in which the abnormalities of behaviour found in psychopathic personalities

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should be regarded as " symptomatic " is increasing as the underlying causes are discovered.

The disturbances of behaviour associated with generalized and focal cerebral disease have received much attention in the past in such conditions as G.P.I., encephalitis lethargica, the presenile and senile dementias, disseminated sclerosis, cerebral arteriosclerosis, cerebral injury and epilepsy. These disturbances are often so striking, and in certain instances resemble so closely those found in psychopathy, that it is natural that attempts should have been made to discover cerebral lesions in cases of psychopathic personality. In no condition, with the possible exception of post-traumatic personality changes following head injury, is this similarity more strikingly demonstrated than in epilepsy. Thus, Gottschalk (1942) describes the " epileptic personality " of the chronic institutional psychotic epileptic as egocentric, subject to outbursts of rage, stubborn, inflexible, boastful, irritable, hypersensitive, explosive, suspicious, oversolicitous, variable in work habits and unrestrained.

Ingham (1938) suggested that in psychopathic personalities " the intricate structural patterns of the brain may be so built up that despite a high degree of intelligence the correlated whole in behaviour is defective," and considered that the diencephalon may be defectively developed in these cases.

Wigert (1938) found, as the result of air studies, cerebral changes in 17 out of a series of 50 cases of psychopathic personality.

Alpers (1940), summarizing his own findings and those of Cox (1937) and Dott (1938) in a series of cases in which the hypothalamus was destroyed or its function interfered with by tumour, reports a reversal of the customary personality trends: a lack of inhibition with the development of coarse traits, a failure of appreciation of many of the niceties of life, carelessness in habits, indifference to surroundings and to obvious anti-social tendencies and a partial or complete lack of insight into these changes. In those who survived operation for removal of the tumour the personality once more became normal; whilst in those who died there was no evidence of damage to the cortex.

A fascinating example of the co-operation of physical factors in the production or facilitation of psychopathic behaviour has recently been reported by Hill and Sargant (1943). In this case whenever the blood sugar fell below 100 mgm. per 100 c.c. the EEG became abnormal, and hyperventilation would induce an abnormal electrical discharge in the cortex, which was associated with some degree of impairment of judgment and clouding of consciousness. The subject came under investigation because of a psychopathic outburst, which the evidence (accepted by the jury) suggested had taken place when he was in the above condition and during which he had murdered his mother. Few lines of research in the whole of this difficult field appear to promise more hopefully than the correlation of electro-encephalographic with biochemical findings.

North (1940) advocates that investigation should be made into the possible aetiological significance of birth injury, prolonged anoxaemia during delivery, twilight sleep and the use of anaesthetics during labour, and of such maternal conditions during pregnancy as acute infections, chronic diseases, alcoholism, etc.

As in the case of brain lesions, the elucidation of endocrine dysfunction

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long been regarded as likely to contribute much to the understanding of personality. The common association of hyperthyroidism, myxoedema, eunuchism, etc., with personality changes has led to attempts to make more detailed studies of other endocrine personality relationships.

Thus, for example, Wittkower and Wilson (1940) found that psychological maladjustment was four times as common among a group of women suffering from primary dysmenorrhoea as among a group of normal controls. They considered that this maladjustment took the form of resentment of the female role, chronic anxiety or hypochondriasis, and was sometimes associated with immature physical development. As children many of these women had been boisterous and aggressive. On the other hand, they considered that the childhood of a series of sterile women had been characterized by poor health, timidity, unsociability and deficient self-assertion.

A complete survey of such studies as these, however, as well as of the considerable volume of work upon the personality features of patients suffering from gastric, cardiac, rheumatic and other physical diseases, would entail a consideration of the whole field of psychosomatic medicine, and would scarcely be appropriate or even possibly relevant here. This applies equally to numerous psycho-physiological investigations, such as that of Thompson and Corwin (1942), who claim that the breathing characteristics, e.g. volume of tidal air, which are common amongst schizophrenic patients, are also frequently found among non-psychotic individuals of a schizoid disposition.

(3) *Environmental and psychological factors.*—Cleckley (1941) considers that the failure of the psychopath to make a satisfactory adjustment to life is due to his inability " to grasp emotionally any of the ordinary components of meaning or feeling implicit in the thoughts which he expresses or the experiences he appears to go through." The way in which psychopathic personality differs from the normal consists in an unawareness of the meaning-aspect of human life. There is a selective and far-reaching dissociation involving primarily emotion and more indirectly purpose which, unlike the circumscribed dissociation of hysteria, extends throughout all the range of experience and all the reactions of the total personality. For this form of dissociation Cleckley suggests the name " semantic dementia." He considers that it results from conflicts unsatisfactorily resolved or dealt with by compensation, sublimation, or other mechanisms of adjustment. Plunging deeper, he holds that the development of faulty patterns of behaviour may be due to (1) a failure of partial erotic impulses to synthesize into a practicable genital psycho-sexuality or failure to deal satisfactorily with the Oedipus situation, (2) the need to find a means of escape from inferiority feelings, (3) improper development of the super-ego, or (4) faulty conditioning in the sense in which this term is used by Pavlov and Watson.

While subscribing to the view that a " psychobiologic or psychodynamic " concept is the most useful one in considering the aetiology, Cleckley is unable to single out any one conflict or any particular fixation. As he says, " the deeper levels of the personality in such patients are difficult to investigate because of their inability to achieve a transference reaction and their lack of real sincerity in co-operation."

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It may be considered that the above views do not so much provide an explanation as a description in psychopathological terms, which the author happens to fancy, of what has been observed. The complications of the psychopathological approach to the ill-defined problems of abnormal personalities are well shown in the contribution by Glover (1932) upon the psychopathology of drug-addiction considered from the psychoanalytic standpoint.

Space also precludes any attempted exposition of the very interesting views of Kahn (1931) on the structure of the psychopathic personality; for he uses the term in a wide sense and, in effect, offers a system of psychopathology of quite general application. It may be that such an approach is the most appropriate.

Binder (1942) found that of 350 mothers who had illicit pregnancies, one-third were normal, one-sixth mentally backward and one-half psychopathic; while Henderson (1942) emphasizes the importance of early environmental factors, such as maternal psychopathy, discordant family life, lack of family affection and generally insecure living conditions among illegitimate children. In a series of 34 such children he found that 17 were psychopathic. It is possible, of course, only in individual cases to decide upon the relative importance of inherited and early environmental factors. The home life of the unwanted child is likely to be unsatisfactory whether the mother is psychopathic or not. The great importance of environmental factors in revealing psychopathic personality has been strikingly demonstrated by the call-up of men into the Services.

Treatment.

The view is generally expressed that the treatment of marked psychopathic personality has, so far, baffled both psychotherapy and the law; prolonged analysis and prolonged incarceration have proved equally ineffective.

With regard to the treatment of psychopathic personalities in general, Levine (1942) frankly states that "often the psychopath is more difficult to treat than the neurotic, because the psychopath's difficulties often have a large element of pleasure connected with them, e.g. the pleasures of alcoholism. Psychotherapy, therefore, is up against the added obstacle of the human unwillingness to relinquish pleasure, even though such renunciation would lead eventually to greater pleasure." On the other hand, he states that some forms of psychotherapy may be of real help in the milder cases of psychopathic personality.

Schilder (1938) writes: "With the exception of cases with compulsions and obsessions, neurotic symptoms may be treated in psychopathies with short psychotherapy. If one wants to change the character deviation as such, a deeper form of treatment will be necessary in the majority of cases. Hypnosis is then useless. The general principles of treatment are the same as in the treatment of neurosis, only that special attention has to be given to the resistance coming from the character. . . . Passing symptoms of psychopathic individuals react rather quickly to any type of psychotherapy which is half way rational." In his section on the treatment of drug addiction, Schilder, after stressing the "enormous" difficulties which the therapist encounters,

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says: "I have indications that the final cure of the alcoholic lies in his contact with a group. Alcoholism is, after all, a disease in social relations. The final technique has to be worked out. . . . We are as far from the solution to this important problem from a psychological point of view as from a social point of view."

It may be recalled that of the 23 cases of psychopathy taken on for treatment at the Berlin Psychoanalytic Institute during the ten years for which published results are available, 18 discontinued treatment, 4 were unimproved and only one was classed as "recovered or much improved" (quoted by Hinsie, 1938).

The views expressed by Henderson (1942) may be summarized briefly as follows:

(1) Many of the psychopath's difficulties may straighten out in the process of ageing.

(2) Personal understanding, training, control and management of the environment may achieve a great deal.

(3) Preventive and social measures: Social service, child guidance clinics, child welfare centres, children's courts, the probation system, approved schools, Borstal institutions, and last, but not least, medical education can play their part.

(4) There may be possibilities in shock treatment.

(5) Developments in chemical and pharmacological therapy may occur.

(6) "Joining one of the Services" has been tried and found wanting as a therapeutic measure.

The problem of the treatment of the psychopath is, at present, according to Henderson, essentially a therapeutic challenge; little, so far, can be claimed.

Cleckley (1941) suggests that the first step should be to regard psychopathic personalities as psychotic and to organize special institutions for them, since they are not helped by commitment either to prisons or to mental hospitals. In these special institutions, which he estimates would need to cater for nearly as many individuals as do mental hospitals at present, their abilities would be made use of in work which would help to pay for their maintenance under whatever degree of supervision was necessary to keep them out of trouble. Every effort would be made to "alter existing patterns of personality functioning," if necessary by such drastic measures as shock treatment or even "prefrontal lobotomy" should these appear to hold out any hope of success. If by some such means, a "profound alteration in the psychobiologic functioning of the patient" can be brought about he advocates intensive psychotherapy, and suggests as possibilities distributive analysis combined with constant synthesis and re-education (Diethelm, 1936), Freudian analysis, "general semantics" (Korzybski, 1937), or an approach based upon the Gestalt psychology. In any case, "such facilities for the permanent care of these patients would in time bring to autopsy material never before available on such a scale."

It is, perhaps, somewhat surprising that, in view of their present popularity, more authors have not advocated mutilating operations upon the brain.

A less drastic scheme of rehabilitation is briefly mentioned by Curran (1942) for naval ratings who (as the author states with a facile dogmatism) "suffer

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from pronounced personality disabilities of long standing, i.e. men whom all would agree to regard as psychopaths." In the opinion of the naval neuro-psychiatric specialists these men, although extremely unreliable and unsatisfactory, did not present sufficient evidence of illness to justify discharge on medical grounds. The rehabilitation unit was under executive, not medical authority. The effect on the men's behaviour was regarded as promising. "Of the first forty-nine ratings who, up to June, 1942, had been in the camp for three months or more, eleven had been passed fit for general service at sea, fourteen for various duties (coaling, boiler cleaning and the like ashore), one was discharged from the Navy and three had been transferred to hospital for invaliding."

In general it may be concluded that, in the present state of knowledge, obligatory rehabilitation under discipline and psychiatric supervision appears to offer the best chance of enabling the severe psychopaths, particularly those with anti-social tendencies, to gain some measure of stability and to pull at least some of their weight in society. For the more transient psychopathic manifestations and for neurotic symptoms which arise in a psychopathic setting, relatively simple methods of psychological and environmental management give reasonably good results.

Discussion.

Is it possible to make any synthesis of the varying and divergent views that have been expressed? It would indeed be surprising if people with such varied propensities and attainments as "the unstable" and "the liars and swindlers" (Kraepelin); "the sensitive" and "the affectively cold" (Kahn); "the self-insecure" and "the insensitive type" (Schneider); "the inadequate" and "the pyromaniac" (Strecker and Ebaugh); "the anti-social" and "the sexual psychopaths" (Noyes); sufferers from "nervosity" and "the eccentric" (Bleuler); "the predatory" and "the façade personality" (Menninger, K. A.); "the drug addict" and the individuals "showing other types of neurotic behaviour" (Levine); Napoleon Bonaparte and J. J. Rousseau (Henry); Joan of Arc and T. E. Lawrence (Henderson); Mr. Micawber and Pop-Eye the Sailor (Cleckley),* to name only a few who have been classified as psychopathic personalities, could adequately be contained in a single diagnostic category.

The only conclusion that seems warrantable is that, at some time or other and by some reputable authority, the term psychopathic personality has been used to designate every conceivable type of abnormal character. This is, however, a broad conception, and tells us little except that the abnormality is considered to be an expression of the character, and is therefore likely to be deeply ingrained, if it is not indeed of constitutional origin.

There can, of course, be no doubt that the study of the character or personality (for the two terms will be used here synonymously) of all patients

* It would appear that Pop-Eye is impotent. It is the considered opinion of the Professor that neither Zuleika Dobson nor Peer Gynt should be regarded as psychopaths, for the former "is perhaps more of a phantasy than a definitely created character," and the latter, "too, belongs perhaps as much in Elfland as to the ordinary world," although he "shows a capacity for spiritual failure and a strange unreliability that suggests a translation of our problems, or some aspect of it, into poetry."

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is of fundamental psychiatric importance, nor that the clue to many abnormal mental reactions must, at present, be sought for in the personality of the patient rather than anywhere else. There can be equally no doubt that a large number of abnormal mental reactions do develop in abnormal personalities or, putting it perhaps more clearly the other way round, abnormal personalities are prone to develop abnormal mental reactions. Yet, whilst this may be granted, two important points must be made:

Firstly, not all abnormal characters do in fact develop what can legitimately be regarded as abnormal mental reactions or, in other words, the possession of an abnormal character does not in itself and necessarily constitute a medical problem—unless of course it is most illegitimately so defined. A man can surely be abnormal or unusual or even persistently anti-social without being sick.

Secondly, to equate psychopathic personality with abnormal character is not only likely to result in confusion for the reason just given, but approximates perilously to making the study of psychopathic personality co-extensive with the major part of psychiatry.

It would be quite outside the bounds of practical politics to attempt to review all the studies of "personality" that have been made in medicine. These now include studies of nearly every type of physical and mental disease. Further information on these studies must therefore be sought elsewhere. Yet it could be argued plausibly that omission to make such a review would be to restrict in a wholly arbitrary fashion the limitation of the psychopathic group.

The same lack of unanimity as to what should be regarded as a psychopathic personality accounts for the wide discrepancies in the estimates of the frequency of the condition; for these seem to vary according as to whether the investigator regards the abnormality of the character of the patient or the presenting symptoms shown by him as the more important.

Thus, Cleckley (1941) considers that more than a quarter of the patients admitted to a clinic of over 1,000 beds "for the diagnosis and treatment of neurologic and mental disorders" should be regarded as psychopaths, while Savitt (1940), who points out that only those psychopaths who have psychotic episodes—a small minority—tend to reach hospital, states that "psychosis with psychopathic personality" was the diagnosis of only 2·17 per cent. of the admissions from New York City to all the mental hospitals in New York State during the fifteen-year period 1920–1934. Similarly at Creedmoor State Hospital this diagnosis accounted for only 2·1 per cent. of the admissions during the year 1937–1938.

Hall (1941) gives the following table showing the admission-rate per 100,000 men for the principal psychiatric disorders in the American Army hospitals in 1938:

Constitutional psychopathic state	270
Psychoneuroses	266
Dementia praecox	131
Other psychoses	64
Epilepsy	61
Mental defect	32

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Wittson, Harris, Hunt and Solomon (1942) found the following incidence in 600 consecutive neuropsychiatric cases at a U.S. Naval Training Centre:

Mental defect	33 per cent.
Constitutional psychopathic state (and inferiority)	26 ,,
Neurologic disorder	24 ,,
Psychoneurosis	8 ,,
Psychosis	5 ,,
Illiteracy	4 ,,

Curran (1942) recorded that 5 per cent. of the cases admitted to Royal Naval hospitals and sick quarters in Great Britain in 1940 with neuropsychiatric disorders were diagnosed "psychopathic personality." Grelinger (1940), on the other hand, reported that 51 per cent. of the first 400 Dutch military psychiatric casualties admitted to the central unit of the psychiatric service of the Dutch Army were diagnosed as psychopaths. In this series all reactive depressions were included under this heading.

Is it therefore necessary whilst recognizing confusion to admit defeat, or, like two eminent British psychiatrists, to make an excuse for looking the difficulties firmly in the face and passing by, as when they wrote: "Unless, however, psychiatry takes account of the psychopathic personality, even when not accompanied by symptoms of illness, it cannot study delinquency, disorders of behaviour in children, sexual perversion and other non-obviously medical anomalies which touch very closely on psychiatric problems in their stricter sense, but are omitted for reasons of space"? No further discussion of psychopathic personalities is given in this section on psychological medicine in Price's *Text-book of Medicine* (1941).

In spite of the confusion and disagreement that exist as to the proper limitation of the field, there are certain types of behaviour which all workers seem to agree to call psychopathic. These *psychopathic reactions* are characterized by their transient, episodic uncontrolled and often explosive character and, it may also be added, by their reactivity to environmental factors. The storm may be very violent while it lasts and may take the most diverse forms —loss of temper, impulsive conduct, outbursts of violence, fits of weeping— but it is usually soon over, although it may readily be provoked again.

(Hysteria, through its personal purposiveness and through the tendency of many psychopaths to develop gainfully motivated symptoms, has a special relationship to psychopathic personality. According to Anderson (1941), "The hysterical personality has the power in response to the dissatisfaction in the real self of creating, elaborating and organizing another self, whose attributes are designed to deceive both the creator and his entourage. He lives his other self and ultimately becomes it.")

There are also certain types of personality which all workers would agree to call *psychopathic personalities*, namely, those individuals *par excellence* who indulge repeatedly in anti-social acts, amongst whom the family black sheep or nightmare, and certain types of criminal, are well known examples.

A major source of difficulty would appear to be the double use of the term

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psychopathic to describe both a manifestation of the first kind and a state of the second kind. The former is a more or less transient reaction, the latter a more or less permanent or continuous condition. Trouble arises because they are each defined in terms of the other. Thus, the existence of a psychopathic reaction is inferred from a psychopathic state, and the manifestation of a psychopathic reaction leads to the inference of a psychopathic state. But the association between a psychopathic reaction and a psychopathic state, as these terms are often used, is in fact verbal rather than invariable. Thus, as has been seen, certain authorities have been preoccupied with the criterion of continuity, and have included amongst their psychopathic states persistent abnormalities of instinct, temperament and character (not of an anti-social kind). Such people may seldom or never have shown psychopathic reactions of the typical episodic "short circuit" variety that has just been described. Again other individuals may only exhibit these episodic psychopathic reactions in particular circumstances, and so infrequently as scarcely to qualify them as suffering from psychopathic states rather than tendencies.

It therefore seems essential to emphasize that this distinction between episodic psychopathic reactions and continuous psychopathic states is not always made, and to realize that, as these terms are often used, the inference of one from the other is not possible except for a certain limited group.

Another source of difficulty comes from this lack of clear distinction between psychopathic reactions and psychopathic states. By their nature, psychopathic reactions often have unattractive or undesirable social results; and those psychopathic states which are in fact mainly constituted by the frequency of the psychopathic reactions that are shown are necessarily characterized by the same results. It will, however, be remembered that persistent abnormalities of instinct, character and temperament are also often classified as psychopathic states; and these persistent abnormalities of instinct, character and temperament by no means always occur in socially inadequate or undesirable people.

Again, the attitude adopted by society towards, for example, the same persistent instinctual deviation may differ widely in different periods and places. A good example of this is quoted by Hamilton (1939). Thus, according to Plato: "It is very unjust that the homosexual should be accused of immodesty, for it is not through lack of modesty that they act in this way; it is because they have a strong soul, manly courage and a virile character that they seek their own kind, and this is proved by the fact that with age they seem to be more efficient than the others as servants of the state." But according to Leviticus: "If a man also lieth down with mankind as he lieth with a woman, both of them have committed an abomination. They shall surely be put to death. Their blood shall be upon them." Now, if stress is laid upon what is regarded as anti-social conduct as an essential aspect of the psychopath, the Greek homosexual would not have been a psychopath but the Hebrew homosexual would have been; whilst if stress is laid upon persistent abnormality of impulse or character as a cardinal feature, both would have been psychopaths.

The position that has now been reached may perhaps be summarized as follows. Three main conceptions may be partially disentangled:

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(1) The conception of psychopathy as shown by persistent abnormality of character.

(2) The conception of psychopathy as shown by episodic "short circuit" reactions.

(3) The conception of psychopathy as shown by asocial or anti-social behaviour.

All these manifestations may occur with varying degrees of severity and (with the exception of (1)) frequency; but (again with the exception of (1), which is necessarily always present), they need not all be seen in the same person.

The whole field may thus be divided for convenience into—

(a) *Vulnerable personalities.*—These personalities can perhaps best be described as potentially unstable individuals or bad psychiatric risks. These are the people who have a small margin of reserve and who, when pinched by circumstances, are liable to develop neurotic and psychotic, as well as psychopathic reactions. They may develop one type of reaction on one occasion and another on a later occasion; or, if they are lucky, they may pass through life unscathed.

The large number of such individuals has been strikingly shown in the war, and many of the breakdowns that occur in war have been regarded as psychopathic in this sense. A perusal of some of the figures previously given shows this to be so.

Only one example need be quoted which illustrates the change in the type of reaction that can be shown and the fact that the prognosis need not be poor. Thus a naval rating who had never been to sea exhibited psychopathic reactions by deserting impulsively and repeatedly, and in other ways. After a period of rehabilitation under discipline he showed such improvement that he was considered fit for draft to sea, but on his first trip was subjected to extremely severe enemy action. He did not react to this in a psychopathic way, but developed the symptoms of anxiety state, which he had not shown previously. He has since been able to carry on with good work on shore service (personal communication).

Suitable environmental management, as in this case, provides an essential part of the prophylaxis and treatment of the vulnerable personality and it can be most effective. The importance of trying to fit pegs into the most appropriate hole for them has been shown very clearly in the war, and will doubtless be shown not less clearly afterwards.

The assessment of the degree of vulnerability naturally presents great difficulties, but it can be estimated with varying degrees of accuracy by a careful scrutiny of the past history. Thus, in a study of 100 consecutive neuropsychiatric cases admitted to a naval hospital, Curran and Mallinson (1940) considered that 8 should be diagnosed as psychopathic personality; and the prediction of these cases seems, in view of the past history, to be a relatively easy matter. But they also considered that 39 other cases revealed such a degree of instability in their past history as to render them predictable bad risks for the special stress of naval service. It was arguable whether a number of these cases should not also be classified as psychopathic personalities

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rather than under some other heading. An unsatisfactory personality was, however, only forthcoming in 5 out of 50 surgical control cases. Again, in another study of 88 depressive states, Curran and Mallinson (1941) considered that 15 had unsatisfactory personalities of such a kind as might have served as a warning signal that they would break down under stress. It may be recalled that Grelinger (1940) included all reactive depressions under the heading of psychopathy.

(b) *Unusual or abnormal personalities or characters.*—The distinction from the vulnerable personalities must necessarily be one of degree; but here may be included the wide variety of persistently unusual or abnormal characters whose departure from the common run is more obvious than in the case of the vulnerable personalities.

Unusual personalities are not necessarily potentially unstable or bad psychiatric risks, nor are they necessarily socially undesirable. They would, for example, include well-adjusted homosexuals as well as certain eccentric and remarkable individuals. Unusual personalities of such types may neither request nor require medical treatment.

But on the other hand, many of the personalities which may be called abnormal, such as those commonly classed as schizoids, cycloids, or cyclothymics, hysterics, obsessionals and many more are much more likely to be bad psychiatric risks than is the case for the unusual group. Amongst these abnormal personalities, abnormality shades very readily into the definitely pathological.

(c) *"Sociopathic" personalities.*—The cardinal feature of this group is seen in their asocial or anti-social behaviour. They may be divided in the usual way into those who are predominantly inadequate and those who are predominantly aggressive. The predominantly inadequate correspond to those individuals who are frequently described as exhibiting "constitutional psychopathic inferiority"; weak-willed and easily tired, they provide many of life's failures. The following example of an inadequate sociopath may be quoted. A Newfoundlander enlisted with most of the eligible men in his village in January, 1940. His application was a half-hearted gesture which both he and his mother and, as he said, the whole village were astonished and dismayed to find successful. He had been known for years as a semi-invalid, taking after his father, who had twice been a patient in a mental hospital. He had given up one job after another because it was too strenuous, and his work record consisted of short periods in labouring and farming jobs, longshore fishing, and fish-packing, interspersed by considerable intervals for rest and recuperation. On arrival in this country his humble position, the disappointing pay, and the lack of interest in his hypochondriacal complaints shown by his messmates and superiors in the training depot provoked an intense resentment against the authorities who passed him as physically fit to join up. After a few weeks he reported at the sick bay complaining of pain in the back, which he alleged had been brought on by rifle drill, and frequency of micturition. Full urinary investigation was carried out, including even an intravenous pyelogram and a radiograph of the spine and renal areas; no physical abnormality whatever was discovered. On admission to a Royal Naval Auxiliary

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Hospital his mental state can be briefly described as disgruntled petulance. He was completely taken up with his own symptoms and disappointments; he showed no interest in the war news or the other patients, worked mechanically in the occupational department, and went through the movements in the physical-training class in feeble apathy. He made no improvement at all until the decision to invalid and repatriate him was made.

The predominantly aggressive type of sociopath is actively anti-social rather than merely a burden on others. These sociopathic personalities tend to show psychopathic reactions very readily.

It will be clear that these divisions do not constitute mutually exclusive entities. The members of any group may show in greater or less degree the characteristics of another group, and all of them may exhibit psychopathic reactions with varying degrees of frequency and intensity. Indeed the one feature common to them all is the possession in some form of persistent abnormality of character. This naturally does not prevent the development of mental illness of a neurotic or a psychotic as well as of a "psychopathic" type, and in fact the possession of an abnormal character constitutes some predisposition to these developments.

Environmental factors are of great, but of somewhat different, importance in all three groups. Thus, a vulnerable personality may only be susceptible to certain stimuli. Protected from these specific stimuli, a precariously adjusted individual may be well able to withstand other stresses. Again, abnormal characters form, by definition, a minority of the population. The difficulties they will experience as the result of their peculiarities will vary according to the attitude adopted by the society in which they live. This has been illustrated by the contrast between the Greek and Hebrew attitudes towards homosexuality. Finally, both aggressive and inadequate individuals may be potentially sociopathic; but overt manifestations of this, in the sense of an obvious departure from what is socially acceptable, often depends upon the social setting in which they find themselves placed. Thus, desertion in the Services is an offence; but may correspond to repeated changes of occupation for inadequate reasons in civilian life, which is not an offence. Experience in the war has demonstrated very clearly that incorporation in a disciplined force with rigid standards will often exhibit inadequate and aggressive individuals as sociopathic failures or delinquents.

If the above is a fair summary of the present position, the discussion of the prognosis and treatment of all these various types of vulnerable, unusual, abnormal and sociopathic characters, now all lumped together as psychopathic personalities, must embrace so many factors that it cannot profitably be undertaken before more agreement has been reached on questions of definition and delimitation. Perusal of the literature on the subject shows very clearly that, at the present time, agreement has not been reached. One point may, however, be made. The therapeutic pessimism that is so widespread in the discussion of psychopathic personalities is only justified in the case of the more severe "sociopaths," with which group many writers who have been more specifically interested in the problem of psychopathic personality have been mainly concerned. It may prove that, as certain authors have advocated, these socio-

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paths alone will be designated as psychopathic personalities; but at present this is not the case. Although it may not be possible to effect any radical alteration in any deeply ingrained abnormality of character, much can be done to help individuals who show certain of these abnormalities by environmental and psychotherapeutic and, perhaps in time increasingly, by physical measures as well.

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THE PSYCHONEUROSES.

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To discuss progress in the psychoneuroses without encroaching on the subjects of psychopathology and psychotherapy may appear like an attempt to play Hamlet without the Prince of Denmark. However, there remain certain aspects of aetiology, nosology, differential diagnosis and treatment which are not included in those subjects. It must clearly be understood that the ground covered by the following discussion is strictly limited owing to the above considerations. Thus, psycho-analytic work on the neuroses is to a great extent a matter of psychopathology and psychotherapy, and can therefore find little place in this chapter.

In a period dominated by war, it is natural that attention should be directed mainly to the war neuroses, in the wide sense of the term, and to the modifications in the psychoneuroses brought about by wartime conditions. The role played by physical factors such as blast and concussion thus takes on a new interest. The greater part of this paper will therefore be devoted to such topics.

I. *Work based on Experience in the Last War.*

During the period immediately preceding this war, and for some time after it began (the period popularly known as the "phony war"), a considerable number of papers and a few books were published on the subject of war neurosis, based on the authors' experience of the last war. Valuable and useful as these were, they hardly come under the heading of "recent progress," with one or two exceptions, notably Kardiner's monograph. In addition, we had the benefit of Mira's more recent experience of modern war in Spain; his contributions will be referred to in a later section.

Outstanding in this field is the book edited by Emanuel Miller, entitled *The Neuroses in War* (1940). This contains a review of the literature, followed by contributions from a number of distinguished psychiatrists and psychotherapists, most of whom had experience of the handling of neurotic cases in the last war. The book covers a wide field, and provides a good picture of what was learned at that time.

Mayer-Gross (1939) states that in Germany during the last war he formed the view that war neurosis is not an illness affecting only unstable or psychopathic personalities. He says: "Constitutional mental equipment as an aetiological factor may become entirely negligible when psychological stress, exhaustion or sleeplessness are undermining the moral resistance of the combatant. . . . These severe anxiety states occurring in the front line are

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easy to understand . . . their prognosis is generally good." Experience in the present war of patients who have been subjected to real stress would seem to endorse these statements, though there is a tendency in some quarters to stress constitutional factors; this is probably due to the relative lack of acute stress except at special periods, such as the time of the Dunkirk evacuation. As a result, psychiatrists have had to spend most of their time dealing with patients who have broken down under minimal stress, many of whom should never have been accepted for service. Mayer-Gross goes on to discuss a more chronic type having the symptoms of conversion hysteria, but developing out of an anxiety state or one of severe nervous exhaustion; others, however, with identical symptoms, had had no precedent anxiety state, and many had never even been near the firing-line.

Dillon (1939), discussing "Neuroses among Combatant Troops in the Great War," differentiates five types of acute reaction, as follows:

1. Direct anxiety or fear state characterized by generalized shaking, nervousness, etc.

2. Mental confusion, or stuporous phenomena, generally of short duration, and regarded as more intense and severe instances of Type I.

3. Conversion symptoms.

4. Amnesias and fugues.

5. Combined types.

Type 1 constituted 70 per cent. of the cases seen, type 3, 20 per cent. Comparison with Hubert's (1941) paper shows that the cases seen in France during the period preceding the evacuation of the B.E.F. correspond very closely to Dillon's description.

Kardiner's (1941) monograph, *The Traumatic Neuroses of War*, is based on work done during 1922–1925 in a U.S. Veterans' Hospital. It is partly practical, partly theoretical; only the former part need concern us here. The book does not purport to deal with all psychic disturbances of war, but with "a highly specific syndrome which can be called the *traumatic neurosis*." The importance of this syndrome lies in the severe incapacities to which it gives rise and in the forensic problems of compensation which are involved. Kardiner seeks to establish its symptomatology, the criteria for differential diagnosis, and a rationale for therapy. He distinguishes acute, transitional and stabilized forms; the stabilized forms generally take two to three weeks to appear, but occasionally as much as six months, especially in the case of those forms terminating in epileptiform phenomena. It is the stabilized forms which Kardiner has studied. He describes cases of hypochondriasis, schizophrenia, transference neurosis (phobias, defensive ceremonials and tics), autonomic disturbances (effort syndrome, etc.), sensori-motor disorders (conversion hysteria), and the "epileptic symptom complex." Under this last heading Kardiner groups such conditions as paroxysmal syncopal attacks, corresponding to the hysterical syncope of peacetime; narcoleptic attacks; twilight states, taking the form either of somnambulistic trance or of trance during the waking state, with active hallucinatory experiences and mimicry, usually followed by complete amnesia; also true convulsive states with very deep disturbances of consciousness, or wild gesticulation, stamping of the feet and crying, or partial tetany.

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In this connection he fails to deal with the part played by hyperventilation in many such cases.

Kardiner points out that normally the reaction to psychic shock is a temporary one, though rarely death may occur from vagus stimulation. In the pathological cases the results are deeper and more lasting, and they undergo psychological elaboration after the patient is out of danger, often while he is in hospital, though Kardiner thinks the influence of suggestion has been much exaggerated. Most of the acute cases recovered, but a large number persisted in a chronic form as autonomic disturbances. The most severe and difficult group is that designated as the epileptic symptom complex, and eleven such cases are described. These include cases with severe headaches and intense vertigo, sometimes lapsing into unconsciousness; dazed or confused twilight states; various somatic or peripheral paraesthesias; or complete loss of consciousness, with or without convulsions, which may be accompanied by tongue-biting and relaxation of sphincters. In some cases these attacks come on after some specific external provocation, which proves often to be essentially the same situation as that which caused the original loss of consciousness, i.e. a conditioned reflex mechanism; in other cases they are preceded by an aura, which represents a hallucinatory reproduction of some of the circumstances originally associated with the trauma. Some, while unconscious, re-live their traumatic experiences; others have typical tonic and clonic convulsions.

The amount of anxiety perceived as such is variable, and the more readily the anxiety is utilized in the form of displacement or incorporated into the attack in some way, the less does the disease take on the characteristics of essential epilepsy. Very few cases complain of phobias, and these are never so organized or elaborate as in the transference neuroses; not infrequently it is the unconscious spell itself of which they are afraid. Except those cases which are indistinguishable from epilepsy, all have the typical dreams of the traumatic neurotic. When such dreams have completely ceased, the patient shows an apathy to his spells and lack of interest in his rehabilitation which are equalled only by the true epileptic.

It is clear that Kardiner uses the word " trauma " in the sense of psychic, not somatic trauma, and this is liable to create some confusion, as the term " traumatic neurosis " is so often taken to imply a neurosis consequent upon bodily injury. It is therefore necessary to examine what Kardiner understands by " trauma," though this soon takes us into the realm of psychopathology. After discussing the conditions of modern warfare which predispose to such reactions, e.g. by precipitating an egoistic conflict of great violence and creating an ambivalence towards the group, at once the persecutor and the protector, and so giving rise to disorganized adaptation types, he remarks that none of these changes would be effectual without the actual traumatic situation in the form of exposure to severe shocks and injury. A trauma must be defined as a relationship between an external stimulus and the resources available immediately to adjust to, sidestep, or otherwise master the stimulus. The sudden time factor is important. The result of the trauma is an inhibition of function of the ego in its executive task of adaptation to the external world. A traumatic

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neurosis is a type of adaptation in which no complete restitution takes place, but in which the individual continues with a reduction of resources or a contraction of the ego.

The various forms of the traumatic neurosis show certain constant features besides this contraction of functioning. First, there is fixation on the trauma, for which there is complete amnesia, or else many details of the traumatic experience are missing, and the appropriate affect is either absent, as in some epileptiform cases, or not associated with the trauma. There is reluctance to think of the trauma or anything resembling it, but its effects are constantly active in the patient's dream life. The second feature is the typical dream life, which is strangely stereotyped, with redundant and perseverative images instead of the condensation and compactness found in the dreams of the psychoneurotic. The dream as a rule only begins to say something, but never completes it, and the attempt to get associations is usually futile. The most common content is the threat of annihilation, but there are also frequent dreams in which the patient is the aggressor, though usually defeated. Variants are dreams of frustration, every activity being futile; occupational dreams with obstacles and threatened disaster; guilt dreams of engaging in some hostile pursuit against a loved object, awaking with a profound feeling of guilt. The annihilation dreams are largely responsible for the insomnia; the patient wakens from such a dream with a feeling of relief and goes back to sleep again, often repeating this performance several times in one night. "These three types of dreams say essentially the same thing in different ways; they all reproduce a helpless situation with its tremendous release of disorganized aggression. They all say, 'I am as at birth; I perceive the world, but can do nothing with it, hence it threatens me'."

The third characteristic feature is irritability, which is absent in no case. It concerns chiefly auditory stimuli, but sometimes temperature, pain and tactile stimuli. Physiologically there is lowering of the threshold of stimulation, psychologically there is a state of readiness for fright reactions. These are paroxysmal, lacking organization, and after they are over there remains no residue of anxiety, but only a heightened sensitivity to the stimulus. Thus they differ from a displacement phobia and are more closely related to the syncopal reaction; a loud noise is often the signal for explosive violence or lapse of consciousness, or in milder cases for generalized tremor and fright. Their increased susceptibility to stimuli prevents these patients from falling asleep.

The fourth characteristic is the tendency to aggression and violence, which is always present. These outbursts, which are intimately related to the irritability, are not deliberate but always impulsive and episodic, and they are never found without reactions of tenderness. Inhibitions of aggression take the form of inaptitude and lack of interest in work, fatigability, etc. The intellectual field is contracted, they have great reluctance to think directly and consistently about anything and are distractible and apathetic, though the interest in compensation is vividly maintained.

The course of these conditions is likely to be chronic if they serve some secondary gain, conscious or unconscious; the most important external

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factor is that of compensation. Apart from these factors, the spontaneous course is in the direction of *slow* improvement. They do not get worse with time. Acute stuporous or delirious forms as a rule improve from the acute stage, but remain fixed in some form of epileptoid repetition. Tics and defensive ceremonials are very chronic, but the latter are extremely favourable for treatment. Paralytic cases, once permitted to become chronic, continue unaltered and develop contractures. The epileptiform cases likewise are mainly long, chronic and unaltering.

The prognosis is stated by Kardiner to be good in the acute stages if they are adequately treated and not complicated organically or by compensation factors; but he does not give his grounds for this belief, and it clearly cannot be based on his experience with chronic cases. The sensori-motor types are as a rule hopeless if not recovered within six months—but one's experience suggests that there are many exceptions to this rule. Autonomic disturbances are mostly inaccessible to therapy. Their efficiency is inordinately impaired and their discomfort constant. The prognosis in the epileptiform types is good if there is no injury to the brain, if they are treated immediately and not permitted to leave medical care before complete recovery. If they are compensated on an income basis, the outlook is almost hopeless. The prognosis is also less good if the trauma was inadequate.

In differential diagnosis it is to be noted that in the sensori-motor and epileptiform reactions the typical dream-life may be absent, especially in the more chronic cases. The following points are suggested for differentiating the latter from essential epilepsy: (1) In traumatic neurosis the phenomena begin within a few weeks of the trauma; (2) the attacks are initiated by external stimuli resembling the situation in the original trauma; (3) the aura is usually distinctive, being a reproduction of the last sensation before the loss of consciousness; (4) the dream life during the first year; (5) the character of the seizure; (6) the EEG will help with regard to presence or absence of injury to the brain; (7) the startle reflex may help.

Finally Kardiner discusses the very important social and forensic issues involved. These are due largely to the persistent diminution in the capacity for work shown by these patients, and to the aggravating factor of compensation. Much of the social problem could be prevented by good medical practice. Adequate care immediately after the trauma could substantially reduce the number of chronic cases after the war, as the prognosis is excellent before they become stabilized. This would require proper organization, and treatment by doctors skilled in psychopathology. As to the chronic forms, their treatment would require a large organization of trained psychiatrists, and even then the prognosis would often be extremely dubious. Kardiner would therefore use measures of rehabilitation for them, though the most severe epileptiform cases probably cannot be rehabilitated for any occupation. Some will have to be compensated, but this might be reserved for those who have proved incurable after two or three years in a convalescent camp, running half self-sufficient enterprises with limited responsibility and constant medical care. It seems clear that it is cases of this type which are likely to constitute our main problem after the war, unless they are adequately dealt with now, and it is for this

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reason that it has been felt justifiable to devote so much space to Kardiner's work, which deals with the problem in so thorough a manner. A recent paper by Rado (1942) approaches the question from much the same angle, but is concerned with psychopathology rather than clinical features.

It should be noted that Kardiner holds that the " traumatic neurosis " has a different structure from ordinary transference neuroses. This is a point of some importance in view of the statement frequently made that there is nothing to distinguish war neuroses from those of peace time. This is, of course, true to this extent, that ordinary transference neuroses occur also in war time and in Service patients, and that traumatic neuroses occur also in peace time; but this does not affect the status of the traumatic neurosis.

II. *Neurosis following Head Injury.*

It is a noteworthy omission in Kardiner's work that he fails to discuss seriously the possible role played by head injury in his traumatic neuroses, an omission the more remarkable in that this term is often used to indicate cases following bodily injury. Moreover, there is a striking resemblance between many of the symptoms of " traumatic neurosis " and some which are generally regarded as the organically determined consequence of head injury. Let us therefore examine some of the recent work in this field.

R. Brun (1938) discusses very fully the differential diagnosis between organic and psychoneurotic states after head injuries. He points out that even irreversible late results of cerebral contusion are not always easy to distinguish from reactive psychoneurotic disturbances by the psychic picture alone, especially in those cases where the organic disorder lies more in the region of character and affect. The customary clinical tests of intellectual function can give deceptive results. He prefers to rely on neurological signs. Apart from these cases, he recognizes " functional-organic " pictures due to a cerebral shock acting directly on the vegetative brain centres. This can come about in two different ways; first, as a part-manifestation of a general or circumscribed commotio cerebri, characterized by a vegetative and especially vasomotor symptom-complex, but also by general cerebro-spinal irritability, just as in a classical neurasthenia. This evidently corresponds closely to Symonds' " minor contusion syndrome." The second way in which shock can come about is quite different; it takes place not in a gross mechanical way, but through the cortex, i.e. the action on the vegetative nerve centres is carried out through the mediation of the psyche, yet Brun holds that the symptoms are produced in principle organically, because there is no conscious consideration or reflection. The distinction from psychoneurosis is likened to that between an unconditioned and a conditioned reflex. This savours strongly of casuistry, and shows the dangers of pushing too far the artificial division of body and mind. These latter cases are what Brun calls " Shreckneurosen " (fright neuroses), and his clinical description of them resembles that of Kardiner's traumatic neuroses. However, Brun states that the symptoms are as a rule transient, lasting from a few days to several months at the most; but in a considerable proportion there is an overlay of psychoneurosis, usually hysteria or anxiety hysteria. If there is no predisposition to hysterical symptoms they,

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like the vegetative ones, rapidly disappear. Disposition is not absolutely essential for a fright neurosis, and the experience of war showed that healthy strong peasant youths may fall victim to the overwhelming impression of catastrophic happenings.

The above-mentioned conditions are all regarded by Brun as standing outside the concept of post-traumatic neurosis in the narrower sense, for even the fright neurosis can be described without constraint (zwanglos) as direct brain injury. The two functional-organic syndromes are analogous to Freud's "actual neuroses," neurasthenia and anxiety neurosis respectively. In the true psychoneurosis the trauma is not the only, nor usually the essential factor, which is to be found in the mental experience of the accident and its secondary elaboration, together with its anticipated social and economic consequences. Brun found that 50·5 per cent. of 400 cases of head injury showed neurotic features in this narrower sense; and 26·5 per cent. were purely neurotic. The slighter the brain injury, the greater the tendency to neurosis.

Brend (1941) points out the importance of the differential diagnosis between contusion of the brain following concussion and psychoneurosis, owing to the fact that the Personal Injuries (Emergency Provisions) Act provides that compensation to civilians injured by enemy action shall be payable only for disablement caused by physical injuries. Among 300 persons injured in air raids and diagnosed as shock, concussion, anxiety neurosis, etc., he found 30 per cent. with a typical post-concussion syndrome, 50 per cent. of anxiety states, the remainder showing a combination. He regards the differential diagnosis as a simpler matter than do many other authors. Not less than two-thirds of the "neuroses" consist of a condition for which Brend suggests a new term—"hyperphobosis"—i.e. a condition characterized by terror on hearing air-raid warnings or gunfire and sleeplessness through listening for warnings, often with no evidence of previous neurotic tendencies. Brend does not think this condition should be regarded as a neurosis at all. Although the suggested new term has not come into general use, a number of authors have expressed similar opinions about this condition, which are not inconsistent with Kardiner's views.

Other authors find it much more difficult to draw hard and fast lines between the various syndromes following head injury. Symonds (1942) says, for instance: "As to the distinction between the physiogenic and psychogenic factors in a given case, they appear in most cases so closely intertwined that to separate them is unnatural. . . . It will be understood from what I have said that I regard the practice of dividing the post-contusional states into two groups, labelling the one organic and the other functional, or neurotic, as unprofitable and misleading." Lewis (1942*a*) concurs with this, and says that insistence upon the question, "Is it due to structural damage or is it psychogenic?" is understandable but fallacious; physical damage to the neuraxis can produce neuroses and personality disorders, and yet the ordinary features of the exogenous mental syndrome may be totally lacking. Nor can we conclude that a condition is physiogenic whenever we can prove existent cerebral damage. The criteria of psychogenesis are equally dubious, owing to

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the ease with which one can find psychological "causes" when one sets out to look for them. "I believe that we have no unequivocal criteria, no final distinction, between physiogenic and psychogenic because the search implies a dualism which is not there." Lewis reports a comparison between 64 post-contusional states admitted to a neurosis centre and 64 other neurotic patients, so chosen that in each group there were the same number of conversion hysterias, acute anxiety states, etc. The two groups differed significantly at remarkably few points, and these differences were only on the margin of statistical significance. "The striking thing is that the long-standing, relatively intractable post-contusional syndrome is apt to occur in much the same person as develops a psychiatric syndrome in other circumstances without any brain injury at all." This seems to me to suggest strongly that psychological factors are very important in determining *chronicity*.

Neustatter's (1942) contribution to this problem points in the same direction. He compared the symptoms in three groups, each of 30 patients: (1) soldiers developing psychological disorders who had not been in action; (2) cases subjected to enemy action but not to blast; (3) cases subjected to blast, without gross head injury. In each group, approximately equal numbers showed depression, anxiety, hysterical and obsessional symptoms. The various symptoms of the minor contusion syndrome occurred in practically equal numbers in the three groups. In each group about a third of the cases improved. Seven of group (2) and nine of group (3) showed no signs of unstable past personality, this difference being obviously not significant. Although these results would indicate that it cannot be argued that anxiety symptoms are caused by contusion, Neustatter suggests that it may interfere with their subsidence. This is contrary to the conclusion indicated by Lewis's work. Neustatter's point of view would lessen the harshness in the working of a strict interpretation of the Personal Injuries Act; and in passing it may be remarked that this would apply even more strongly if one were to adopt Brun's theory of the fright neurosis. It would be disastrous, however, if we allowed our scientific judgment to be influenced by administrative considerations.

Similar conclusions emerge from Guttmann's (1943*a* and *b*) recent work based on 255 consecutive cases of civilian head injury, all treated by early rehabilitation. Only half had headache at any time, and in most of those who complained of headache six months after the injury the symptom was precipitated by psychological causes, or else the patient's attitude towards it was determined by such factors. Only eight did not return to work within six months, and of these only two were incapacitated by cerebral damage. Four were definitely neurotic, a fifth very likely so; the compensation problem played a part in three of these cases. "In all those with mild concussion who stayed off work for seven weeks or more, psychological factors could be found to account for the fact." This does not mean that the others were symptom-free, but that they were able to adjust themselves to their symptoms. Jefferson (1942), Cairns (1942) and Brain (1942) all express corroboratory views.

Schilder (1940) discusses at some length the problem of neuroses following head and brain injuries. After defining a neurosis with some precision, he states that a traumatic neurosis is one which follows an injury to the body,

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the trauma bringing about psychological changes. The physiological consequences, especially as they affect the structure and function of the brain, do not constitute the neurosis, but offer material for the neurosis, as far as the individual is aware of them. The post-concussion (minor contusion) syndrome is an organic syndrome even in its psychological manifestations and cannot be classified as a neurosis ; but the objective impairment and subjective experiences originating in organic cerebral changes may become the nucleus for neurotic attitudes. The traumatic neurosis following head injury may, however, be related merely to the psychic experience of the trauma. In particular, feelings of insecurity and changes in consciousness connected with dizziness of central or peripheral origin facilitate neurotic attitudes. Traumas in other parts do not have this effect, so one is justified in differentiating neuroses following head injury from other traumatic neuroses ; this is true also on account of the particular psychological value which an individual places on his head. These points seem to have been overlooked by most other authors. Schilder divides these neuroses into four groups, as follows : (1) anxiety and terror reactions, (2) neurasthenia and hypochondria, (3) hysteria, (4) social reactions, connected with compensation, etc.

Crichton-Miller (1941) maintains that though the name " shell-shock " has been officially banned, cases do occur of blast-concussion, and he puts forward an interesting, if speculative suggestion as to how they may come about ; he supposes that damage may be caused to the brain cells by displacement of fluid owing to compression and suction acting on the elastic abdominal wall. Such a condition would have no psychogenesis, but the effects would depend on the emotional state at the time of the trauma. The worst effects, he says, are seen in the unwounded, because the wounded are able to get the rest they need without loss of prestige. Recovery is influenced by fatigue, age, and other factors. Fatigue is associated with a fall in blood sugar, and indiscriminate administration of sugar may convert a fatigue apathy into an anxiety.

Discussing the same subject, Anderson (1942) describes eight cases, but in most of them it was impossible to exclude an ordinary head injury. He regards them all as showing evidence of an organic reaction, with intellectual impairment in six, memory changes in all cases (though retrograde amnesia was absent in all cases), changes (but not loss) of consciousness, affective lability and apathy, general psychomotor slowing, etc. The EEG was negative in all cases where it was done. Anderson urges that every case exposed to blast should be referred to hospital with a view to immediate psychiatric examination, including a searching organic and neurological examination, examination of the C.S.F., an EEG, and autopsy in fatal cases. But the trouble is that even if one had all these data at one's disposal, even including the autopsy, an unbiased observer might still be in some doubt as to which of the symptoms could be explained on purely organic grounds.

Before leaving this subject mention may be made of one of the extreme exponents of the organic theory of the psychoneuroses. Wigert (1938) approached the problem by the method of encephalography, in which he had the collaboration of a first-rate radiologist (Lysholm). Starting out from the fact that psychopathic pictures may be produced by brain damage, he examined

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50 constitutional psychopaths; in 17 of these he found demonstrable cerebral changes. The 50 were not, however, unselected. Wigert believes that a "psychoneurosis" is the psychic reaction or adaptation in a characterologically peculiar individual, and that this peculiarity differs only in degree, if at all, from that of the psychopaths. He therefore examined a number of psychoneurotics. He reports that the results were "not negative," but gives no figures. He quotes four cases, but does not describe them sufficiently fully to enable one to come to an independent diagnosis. Now the X-rays show only the grossest type of damage; if we make the assumption that it shows only one case in ten of organic damage, we can say that cerebral changes occur frequently in the psychoneuroses. Radical as this may sound, it is not in fact far removed from the point of view put forward by Henderson in his "Psychopathic States," with the exception that Wigert postulates an organic basis for the psychopathy. The obvious continuation of this research would be by the autopsy method, and it is amazing how this has been neglected in the study of the psychoneuroses. Grünthal (quoted by Mayer-Gross 1939), demonstrated gross cortical damage post-mortem in 17 cases diagnosed as pure "compensation neurosis."

III. *Psychoneuroses in the Services.*

Rees (1943) gives a general survey of military psychiatry in the United Kingdom, only a small part of which is relevant to the psychoneuroses. Psychiatrists have found that prophylaxis is the most important part of their work; acute war neurosis has been one of the minor problems. Rees gives reasons why the "psychopathic tenth" tends to find its way into the Army, thus providing a large number who are constitutionally predisposed to neurosis, of whom only a small proportion are likely to benefit sufficiently from treatment to warrant their retention in the Army. An extremely useful experiment undertaken in the last 18 months consists of the placing of men occupationally (the so-called "Annexure" scheme). Only 9 per cent. of the men so dealt with have turned out failures, and over 70 per cent. have been very successful. Given early treatment, the results in acute war neurosis have also been very successful, and especially so in the Middle East forces.

Hadfield (1942) finds that the most striking change compared with the last war is the far greater proportion of anxiety states as against conversion hysteria —64 per cent. against 29 per cent. out of 577 cases of psychoneurosis seen in hospital. He attributes this to the relative lack of traumatic cases and the greater number of chronic neurotics recruited in this war, and the fact that air raids have brought the front line nearer. Thus Dillon found 70 per cent. anxieties and 20 per cent. hysterias in casualty clearing stations in the last war. But many of these front line anxieties, as Hadfield points out, are not true neuroses, but simple states of fear that pass away with the passing of the danger, and our aim should be to catch the cases before they pass on to the stage of amnesia, repression or dissociation. In fact, however, the average period between the time when a man first went sick with neurosis in this country and his admission to a neuropathic hospital was 7½ months! Only 40 per cent. could be regarded as war casualties, and 19 per cent. were considered attribu-

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table to war service. 82 per cent. showed constitutional or acquired predisposition; in 69 per cent. it was found in early childhood. In a more detailed investigation, only 3 out of 100 showed no psychological predisposition. Even among traumatic cases, very few were entirely due to the severity of present-day experiences. Many volunteered the statement that they had been nervous all their lives, and this was checked by a questionary sent to their parents which carefully avoided leading questions and elicited confirmation in 30 out of 37 cases. The figures confirm the expected inverse ratio between degree of predisposition and degree of aggravation necessary to produce breakdown. An interesting point is that a surprisingly high proportion were well adapted physically, to school, and to work; indeed, 41 per cent. were well adapted even to Army life, only 31 per cent. ill-adapted. In "mental life," however, they were relatively ill-adapted. One is justified, I think, in hesitating to accept these subjective self-valuations at face value; the soldier is particularly apt to see his civilian past through rose-coloured spectacles. Hadfield supports the view that "without a predisposition, circumstances, however bad, do not or rarely produce a neurosis." Even traumatic experiences may be "simply tags on which the patient conveniently projects his previously existing problems." There is no doubt much truth in this, yet one cannot but wonder what percentage of the population would be found free from such predisposing factors on diligent search. The results of treatment were rather disappointing; even the "Annexure" scheme did not absorb as many men as was expected, and the larger number had to be invalided. This result is attributed to the fact that 42 per cent. were regarded as having been unsuitable for the Army from the first.

Lewis and Slater (1942) investigated the medical records of 300 soldiers who had been returned to the Army after treatment at two E.M.S. neurosis centres, of whom 150 had subsequently been discharged, the other half being on full duty some months later. The traits found with significantly greater frequency in men who proved unsuitable for military duty were: a history of mental disturbance, including neurosis, in parents or siblings; unsatisfactory work record prior to enlistment; psychopathic traits of personality; symptoms of the present illness before enlistment; resentment or strong dislike of Army life; reluctance to return to Army duties; onset of illness without exposure to bombardment, continuous danger and other stresses of active service; querulous hypochondriasis; fugue or amnesia; and surly or paranoid attitude. Prognosis, they point out, cannot be safely based on the mere *number* of such traits a patient has; it depends also on their degree, and on the favourable attitudes discovered.

Aiken (1941) studied two groups of New Zealanders on a hospital ship conveying them home after the campaigns in Greece and Crete. A highly significant proportion had never been engaged in fighting. Of 55 cases, half were 35 years old or over, 20 were 40 or over. A definite previous nervous illness was found in 20 cases, and a family history in 22. The majority conformed to the accepted pictures of neurosis, most being anxiety states, the result either of long continued strain or acute shock. The hysterics presented largely cutaneous anaesthesias, paralyses being uncommon.

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Curran and Mallinson (1940) report on 100 men admitted to the neuropsychiatric unit of a naval hospital, and compare them with 50 surgical controls. Only 26 per cent. of the former had experienced enemy action. The type of reaction most commonly encountered was a mixture of anxiety and depression. There was not one classical case of conversion hysteria, though 13 were described as hysteria without anxiety; 20 were anxiety states, 7 anxiety with hysteria; there were 11 reactive depressions and 31 endogenous depressions, but only 1 obsessional, despite the extreme conscientiousness of many naval ratings. Though none were admitted as the direct result of head injury, 11 had a history of severe concussion—a fact suggesting that previous concussion predisposes to breakdown. It would not be surprising if the different type of personnel and the different type of stress in the Navy should tend to produce a rather different symptomatology, as this paper seems to indicate; the most striking feature is the high proportion of depressions. It must be remembered, however, that a large proportion of cases usually classified as anxiety states also show depression, and the number diagnosed under one heading or the other depends to a large extent on the bias of the observer. Another fact that detracts from the value of any such comparisons unless based on a very large number of cases is the marked fluctuations in the type of material coming into any one hospital at different periods.

Curran and Mallinson considered that 39 of the 100 breakdowns should have been predictable on the basis of family history, past history, personality, and physical factors. It was found that a high proportion of the cases not regarded as predictable showed a positive family history—a fact which suggests that more weight ought to be given to this factor. 33 per cent. were returned to duty. The authors discuss the very important question of the rehabilitation of those discharged, and the urgent need for an organization to help them find their way into work of national importance, of which the great majority are potentially capable.

Let us turn now to the neuroses associated with active warfare. Hubert (1941) reports his findings at a psychiatric centre in France during the active phase of the campaign. There was a steadily increasing amount of acute illness after the invasion of Holland, till finally admissions consisted almost entirely of conditions precipitated by bombing, shelling, etc. These cases were classified as:

(1) Anxiety states: Most had had previous anxiety symptoms recently. After some special ordeal, the climax came usually with "collapse," in which they showed uncontrolled emotion, followed by a brief period when they seemed paralysed with fear for some hours. After a few days there was an increasing tendency to dissociate fear and anxiety attacks from real happenings, the attacks occurring without the stimulus of a plane or other noise.

(2) Hysterical states: Most of these had no previous history, though some were of hysterical personality. The onset was usually sudden, without the prodromal symptoms seen in the anxieties. They often described a sudden collapse, usually at a time of intense stress; often the patient would lie motionless until carried off on a stretcher "unconscious." During the next few hours up to two days there was a transition from a negative semi-stuporose condition

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to a hysterical picture. Often function would return save in one field, such as speech or vision. Gross tremor was common. Amnesias showed an unexpected feature, in that many could give a complete history at first, the memory becoming lost later.

(3) Psychogenic stupor: This followed stresses similar to those found in (1) and (2). Their previous history appeared uneventful and their Army records satisfactory. They were motionless, mute, and insensitive to ordinary stimuli, responding only momentarily and slightly to severe stimuli. There was no evidence of organic injury to the central nervous system. The more severe cases were incontinent of urine and faeces. There were a few features resembling catatonic stupor. The striking feature was their rapid recovery to comparative health, without neurotic or gross psychotic residual. "They would become, apparently, perfectly well, except for features not uncommon after a severe psychotic illness, such as pallor, poor appetite and sleep, and a mental state difficult to describe, but compounded of timidity and bewilderment."

(4) A very small mixed group with psychotic symptoms.

Sargant and Slater (1940) seeing a similar group at a slightly later stage after the evacuation from Dunkirk, give a description quite consistent with Hubert's. The patients showed signs of physical exhaustion, with an expression and attitude of tension and anxiety or listless apathy. Coarse irregular tremor was exceedingly common, sometimes resembling the extrapyramidal type, and there was often an immobile facies, so that some cases had been sent in as parkinsonism. Mentally they complained of sleeplessness, terrifying dreams, a feeling of inner unrest, and a tendency to be startled at the least noise, particularly anything resembling a plane. Many had more or less extensive amnesia, and other hysterical features were observed. The course was uniformly towards improvement, and the appearance changed strikingly within a few days, though the completeness of recovery was considered doubtful, as they remained easily upset by slight stimuli, sleeping uneasily, with bad dreams, and lacking their old self-confidence. The authors' remarks on prognosis are very properly guarded, their paper having appeared barely a month after Dunkirk; later experience showed that many of these men did not do nearly so well as was at first hoped, particularly if the attempt was made to return them to the Army. (See e.g. Sargant and Slater, 1941.)

Sutherland (1941) reports on 100 men admitted to an E.M.S. hospital suffering from psychoneurotic states occurring during or after exposure to combatant action. Of these, 12 were sergeants or warrant officers—a fact attributed to their greater age, and their rank having been given for technical experience rather than personal qualities. Thirty-seven were thought to have joined up with an unsatisfactory attitude or motive. Eighty admitted traits indicating previous emotional instability, 36 having had a definite psychoneurotic condition in the past, and none of these should ever have been exposed to combatant action. Of the 20 men with a good previous history, one group consisted of men over 35, another group, with a milder type of breakdown, were under 25. A family history was obtained in 53 cases.

It was found difficult to ascertain the extent of shock or whether concussion

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had been present. Many reported amnesia, but the memory was easily recovered and most could recall the stimulus causing the loss of memory, i.e. there was no retrograde amnesia. There was one case of cranial injury, three of true concussion. Seventeen had been blasted, though few of these lost consciousness. The onset occurred mostly *during* battle, but a quarter developed marked symptoms after return to this country, mostly depression supervening on previous mild anxiety symptoms. The majority admitted readily that the illness began as a climax to a rising feeling of fear and strain under the process of battle, with increasing fear of loss of control. Different traumata evoked similar states, and the same trauma might give rise to different disturbances, depending on the subjective significance of the trauma and the make-up of the individual. Like Hadfield, Sutherland found an inverse ratio between the severity of the trauma and of the predisposition. There were three main groups: anxious, depressed and hysterical. Cases of effort syndrome were included with the anxiety neuroses, as they showed anxiety symptoms at some stage without exception, and in some cases it was possible to observe the development of an effort syndrome with corresponding diminution in the experience of anxiety (*cf.* Kardiner). Depression was dominant in 13, though in only 2 cases did a typical psychotic depressive picture with self-reproach develop. They had chiefly a feeling of futility and withdrawal of interest from the outside world, with irritability (again *cf.* Kardiner). Five were suicidal, and several stated that they would rather commit suicide than experience again what they had undergone. In this depressed group there was a previous history of pronounced emotional disturbance in 90 per cent. and a positive family history in 70 per cent. (not necessarily of depression, however, it would seem). Thirty-four had superficially complete hysterical conversion, denying any emotional upset. Their average intelligence was about two years lower than that of the other groups.

In general, then, it will be seen that there is a marked measure of agreement between different observers about the clinical pictures produced by active service conditions; moreover, there is a close correspondence with the pictures observed in the last war, as described by Kardiner and others.

IV. *Civilian War Neuroses.*

This subject, together with a number of others which have been touched upon in this chapter, has been dealt with by R. D. Gillespie in his recent book (1942). This book is so full of matter and covers so much the same ground as this chapter attempts, in a much more sketchy way, to do that it would be absurd to attempt to review it here, and the reader is advised to read it for himself.

The effect upon neurotic patients of the mere threat of war at the time of the Munich crisis in 1938 has received rather little attention. It was investigated by Glover (1941) by means of a questionnaire sent to psycho-analysts. It was found that the majority of patients reacted in some way, mostly by being "upset," but others by improvement in symptoms; a minority were unaffected. Most reacted with anxiety of varying degrees, but there were numerous other forms of reaction, and Glover thought that they reacted in accordance with

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their clinical type. Lack of reaction seemed to occur independently of clinical type. Most of those who were relieved during the crisis, but also some who were frightened, reacted with depression or disappointment to the "peace." There was much difference of opinion as to whether analysis (previous and current) modified the reaction.

Observations in the pre-blitz year were largely negative, and such reactions as did occur fell into the same group as the Munich reactions. A Psychological Aid Centre set up at the Clinic of Psychoanalysis for the express purpose of dealing with war neurosis had only 29 consultations up to the time of Dunkirk; most of these came before the end of 1939. Half of them had no relation to war conditions, and six more had suffered from neurotic symptoms before the war.

Another investigation of the behaviour of chronic neurotics in the pre-blitz period was made by Rosenberg and Guttmann (1940), who examined 96 such patients who had been attending psychiatric out-patient clinics for at least a year before the war. This showed that by March, 1940, 17 had improved, 56 were unaffected, and 23 were worse. The criticism that the worst affected may have evacuated themselves is met by the fact that although 30 ceased to attend at the outbreak of war, all but 7 were followed up and accounted for. Obsessional, hypochondriacal, and chronic hysterical patients were outstandingly unaffected by the war. Those with mild depression or chronic anxiety showed themselves much more likely to become acutely ill under conditions of stress; those of the latter group who showed improvement were mostly those who had taken up work directly connected with the war, or who had become absorbingly interested in political events.

Wilson (1940) also found that his old neurotic patients did well on the whole. He refers to numerous states of anxiety seen in September, 1939, which soon subsided. The fall of France led to anxiety states, with symptoms largely referable to the stomach or thorax, also a growth of suspiciousness about "fifth columnists." During intense air-raiding there were fewer hysterical and neurotic patients than were expected. Early hysterical symptoms *in statu nascendi* were easily dissipated. Some patients were chiefly worried by the fear of breaking down in face of their friends and neighbours.

Pegge (1940) reported that of 29 cases seen after bombing, 9 had a previous history of neurotic illness (though 4 of these were considered mainly attributable to war stress); 10 were said to be nervous or highly strung; 3 showed no predisposing factors; 4 were mild psychotic or psychopathic personalities; 2 were complicated by concussion. The majority showed some derangement of consciousness, varying from a stuporous to a mildly dazed state. There was often some amnesia in those not unconscious or stuporous. Tremor was common, and was exaggerated on gunfire, being usually accompanied by uncontrolled emotional behaviour and weeping. There was only one localized hysterical paralysis, in a long-standing hysteric.

That these conditions are generally transient is suggested by Wilson's (1942) observation that of 134 cases of acute emotional reaction to air raids admitted to a first-aid post, only 6 returned for subsequent treatment. He found also that in 63 patients with subacute symptoms due to air-raid stress

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psychopathic traits were two and a half times as common as in controls; the controls were far more *conscious* of the fear excited by aerial bombardment. Admission and acceptance of fear is a safeguard against breakdown. This is a point of some importance, which the experience of others has confirmed.

Brown's (1941) observations on air-raid casualties showed five types of reaction: (1) acute emotional shock with tremor and other signs of fear, but no amnesia; (2) acute transient hysterical reactions—a limp semi-stuporose state in which they seemed to be groping for hysterical symptoms; (3) psychoneuroses, all hysterical, and rare in those who have previously shown no neurotic traits, these need a particularly horrible experience to precipitate this reaction, which occurs only after a period of meditation; (4) exacerbations of existing psychoneuroses, mainly in hysterics—but in some well-established psychoneuroses the anxiety or obsessional state gives a feeling of security against bombing; (5) psychoses of various types.

In general, then, experience shows that stable persons are unlikely to break down under the stress of bombing except in particularly trying circumstances; the unstable may react in different ways—a previously existing neurotic condition may be either exacerbated or improved, and a latent condition may be precipitated by the bombing.

Maclay and Whitby (1942) report remarkably good results from the in-patient treatment of 100 civilian neurotic casualties, even though the average duration of the condition on admission was seven months. Half of them had left hospital in two months. Altogether 48 were recovered or much improved, and 51 returned to their old work, 25 to light work. Their previous records were good on the whole. Eighty-six of them had endured severe mental stress as a result of bombing, and in 50 there was more than minor physical injury. Pension considerations were important in only 13 cases, and it was felt that the group as a whole were comparable rather to the "Dunkirk cases" among soldiers than to the compensation neuroses of peacetime.

Summarizing a fairly extensive survey of the incidence of neurosis in England under war conditions, Lewis (1942*b*) finds that air raids have not been responsible for any striking increase in neurotic illness. After intensive raids there is a slight rise in the total amount of neurotic illness in the affected area; neurotic reactions may not show themselves for a week or so and usually clear up readily. Hysteria is uncommon, anxiety and depression commonest. The incidence has been low in firefighters and other civil defence workers. These conclusions are partly based on careful statistical work derived from a London general practice, work which has been lately published in more detail (Whitby, 1943).

Fraser *et alii* (1943), investigating the population of a heavily bombed city, found that of the 35 persons who had been buried for over one hour, 66 per cent. developed "neurotic" symptoms, so that this may be regarded as a "normal" response to such an experience; the neurosis was persistent for ten months in about half the cases, i.e. about a third of all cases buried for an hour develop a persistent neurosis. These authors concluded that this is likely to occur when the personality is unstable and living conditions have become an abnormal strain, either due to general difficulties or to residence in the danger-area

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despite the absence of confidence. But the most interesting thing that seems to be established here is that the majority of the population is liable to develop a neurosis under certain conditions, and as often as not a persistent one. The question whether it is possible to develop a neurosis without a predisposition is thus answered very definitely, unless the concept of predisposition is to be stretched to the point at which it becomes meaningless. The question remains, however, whether these neuroses are of the same structure as ordinary psychoneuroses. The general opinion would probably be that they are, at least in the case of the persistent ones; but Kardiner would no doubt deny this, and much weight must be attached to his opinion, owing to the amount of intensive work he has done on the subject.

V. *Special Psychoneuroses.*

Hysteria.—Schilder (1939) discusses the concept of hysteria. He emphasizes that it is characterized by physical suffering, not accompanied by severe physiological and organic changes, nor by a deeper biological adaptation disturbance. As every type of neurosis has its physical side, the problem of conversion hysteria is not why the physical symptomatology appears, but why these particular symptoms make their appearance. Much confusion has been caused by failure to distinguish between the psychoneurosis, hysteria, correlated with the hysterical character, and on the other hand hysterical symptoms or reaction. "Every individual who has access to reality prefers under certain circumstances to forget this reality." There is always a real event at the basis of conversion, in which the body image always plays the most important part. Although the conversion is based on childhood experiences, the later organic trauma may be the nucleus and pattern for the formation of symptoms; e.g. amnesia and memory disturbances in patients who have suffered organic unconsciousness. Early organic ailments are also of fundamental importance in the relation to the parents, concentrating the parents' love on the child and increasing his dependence. "Reactive depressions are, according to their structure, hysterias in which the present situation plays an outstanding part." This is an interesting point of view, which should be compared with the recent tendency to see depression in hysteria (cf. Rickman, 1941).

Kennedy (1940) has made a thoughtful contribution to the subject of recent hysterical states, which he regards as a pathological exaggeration of a normal protective mechanism for gaining time in face of a reverse by "flight into activity, non-realization, and incapacity." "It might be said that anyone is a potential hysteric." Here it is useful to recall Schilder's distinction between symptom and psychoneurosis—Kennedy's statement is probably true only of the former. He offers a new classification of hysterical reactions based on (1) flight into activity or inactivity (panic, terror, denial of consciousness); (2) transition states where relative freedom from anxiety is secured by symptoms which prevent full realization of difficulties or relieve the patient of the obligation of action (twilight states, fugues, amnesias, aphonia, astasia, pseudopsychosis, etc.); (3) functional incapacity used as a means of retreat, but not permanently, as in chronic hysteria (paraplegia, aphonia, etc.). Kennedy points out that the difficulty in diagnosis is not in the differentiation from a wholly

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organic condition, but in detecting important organic factors as a background to a hysterical state. In prognosis he lays stress on physical and constitutional factors, previous personality, intensity and duration of stress and extent to which the patients can be shielded from similar stress on recovery. Acute changes from the previous personality, such as panic and terror reactions, have the best prognosis.

Amnesias and fugues.—Sargant and Slater (1941) reported that no fewer than 144 out of the first 1,000 military cases admitted to the neurological unit at Sutton had loss of memory as a prominent symptom. Well over a half of these cases had been subjected to severe stress, and of all those exposed to *severe* stress, 35 per cent. had an amnesic syndrome. It was shown that terror, bomb blast and exhaustion may produce these conditions. Head injury was a factor in ten cases; but nearly a quarter of the psychoneurotic patients date their amnesic disturbances from concussion or from being blown over and dazed by a bomb. 32 men broke down in the absence of military stress, 28 of them having fugues; constitutional inferiority was found more frequently in these men. Among the normal men who broke down under stress there was found very frequently an outgoing type of personality, popular, fond of company, quickly responsive emotionally with somewhat shallow affect. Others showed paranoid tendencies, unsociability and poor energy output. Only seven out of 77 who passed through severe stress showed an association of amnesia with guilt; it was for the horrors and strains of retreat that forgetfulness was desired. But the paper does not attempt to determine what factors are associated with poor outcome, and leaves open the question to what extent *prolonged* neurosis may be due to such factors as guilt, or for that matter cerebral injury—a very important consideration both theoretically and from the practical, e.g. pension, point of view. The facts adduced, however, conclusively contradict Gillespie's (1942) sweeping remarks on the subject, in which he says amnesia is exceptional, and suggests shame or facilitates escape from the consequences of evasion of duty (p. 195).

Stengel's (1941) study of 25 cases of fugue seen in peacetime over a period of eight years gives an entirely different picture. Ten of these cases were related to epilepsy either in the patient or in his family, one was a schizophrenic, and the remainder were typical manic-depressives, hysterics and psychopaths. The three essential conditions for the production of these states were a tendency to periodic changes of mood, a disturbance of home conditions in childhood, usually affecting the relationship to the parent of the opposite sex, and a tendency towards the production of twilight states, most prominently in the epileptics.

Fear and anxiety states.—These have already been discussed at some length, but there are two further contributions to the subject which should be mentioned. Mira (1939*a*) made some suggestions about the relations between the different varieties of these states. Following Pavlov, he assumes that fear involves the predominance of a physical process of inhibition. Terror then corresponds to a general inhibition, leading to loss of movements and stopping of mental activity with eventual loss of consciousness. Panic is related to "cortex" inhibition with secondary excitation of the midbrain, leading to aimless

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automatic movements, occasionally of great strength. Anxiety is a mixed state, with conflicting inhibition and excitation at different levels. Thus, terror leads to stupor and catatonic states; panic to twilight states, impulsive fugues and confused agitation; anxiety to hypochondriacal states, obsessional (phobic) symptoms, and hysterical fits. All may lead to conversion symptoms, especially paretic ones, neurasthenic symptoms and slight retardation.

Mira (1939*b*) also described a malignant type of anxiety which he called "psychorrhexis"; 100 such cases were observed in Spain, making 2–3 per cent. of all psychiatric cases. They showed anguish and perplexity rather than fear or excitement. The pulse was permanently above 120, respiration above 40. At the end of the first week the temperature rose very quickly, the general condition became worse, the tongue became ulcerated, with slight jaundice and a tympanitic abdomen. They became restless, developed automatic movements, carphologia, subsultus tendinum and facial spasms. In fatal cases death occurred after three or four days. Unfortunately there were no necropsies. The predisposing conditions were previous lability of the sympathetic, sudden severe mental shock in conditions of physical exhaustion, and long delay before starting sedative treatment. No one has reported anything similar in this country, though one would have thought that the conditions at Dunkirk might have reproduced many of the factors operating in Spain.

Finally, Palmer (1941) discusses the acute anxiety attack, which, as he points out, is referred to by the neurologist and cardiologist as a vaso-vagal attack. The setting in which the attacks occur is of the utmost importance. First, as to diathesis: "Where there is a family or personal history of epilepsy, migraine, asthma or hay-fever; where the attacks are occurring with a fairly regular periodicity; where the attacks are fulminating and punched-out in expression; and finally where their occurrence is more frequent than twice a week, we may assume that the patient is so diathetically predisposed to their occurrence that an intensive psychological approach is likely to be disappointing." Secondly, the setting of psychic morbidity is important, i.e. to what psychiatric group does the patient belong if the condition is psychogenic. Such attacks occur in anxiety states, in the phobic-obsessional group, in certain alcoholics, in hysteria, hypochondriacal, functional cardiac states, and in a psychotic group.

If well founded, the author's conclusions about the contra-indications for psychotherapy would be most important, and just the kind of thing we need; but it is not clear on how much evidence his conclusions are based, and one feels they are somewhat *ex cathedra*. He quotes 11 cases, but most of them are not relevant to this particular question of diathesis.

Considerations of space forbid the discussion of numerous other interesting topics, in particular the psychosomatic disorders, which would require a chapter to themselves. One group of them is dealt with, however, under the heading of "Effort Syndrome."

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PSYCHOTHERAPY.

By H. CRICHTON-MILLER, F.R.C.P., AND GRACE H. NICOLLE, M.B.

THE present war has occasioned sudden and notable changes in many aspects of medicine. Psychotherapy is no exception. The war has come at a time when this branch of treatment is receiving a greater measure of acceptance by the profession than ever before. And the war has brought with it a challenging demand for shorter treatment and—if it may be—more permanent results. Thirty or forty years ago psychiatry complacently limited itself to environmental and custodial measures. Since then a gradual infiltration has taken place whereby the psychiatrist accepts an active therapeutic commission. Much of this change is due, directly and indirectly, to the work of Freud, which shook into animation both clinical psychiatry and academic psychology. The interdependence of these three departments of mental science has by no means reached completion. Nevertheless, psychotherapy can look back on a growing contribution to psychiatry, initiated to a large extent in the Great War, and now multiplied many times by the demands of totalitarian warfare.

A good deal has been written on the value of superficial psychotherapy. McLaughlin (1942) describes a routine for R.M.O's. at sick parade which aims at detecting the maladjusted young soldier. To this end he gives him a simple talk on his difficulties in order that he may the better adapt himself to army life to avoid drifting into a breakdown. Hubert (1941) discusses acute nervous illness in active warfare under the three headings of anxiety, hysteria and psychosis. For the recoverable, as opposed to those diagnosed as chronic, he advocates a speedy return to duty. He uses sedation, and follows it up with psychotherapy directed to the general nature of the condition rather than to the individual's reaction. His intention is to enable the patient to tolerate army discipline as soon as possible. Snowden (1940) elaborates a system of group instruction applicable to service patients, but more suitable for civilians. Analysis is avoided as too lengthy. A preliminary history is taken by an assistant, and that is followed by a single diagnostic interview. In this interview investigation is directed to certain main aspects of life, childhood, school life, adolescence, work, marriage. The patient is then drafted into a group. Eight lectures, each lasting twenty minutes, are given. After the lecture the group discuss among themselves. Then the M.O. sees each member of the group for five minutes. Stress is laid on the importance of not giving more time to one patient than another. Satisfactory results are claimed.

Another system of group psychotherapy is described by Wender (1938) as applicable to psychoneurotics and mild psychotics. His aim is to use the new environment and social contacts in the hospital to adjust former family and social conflicts. These are visualized by the physician in analytical terms.

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The patients are divided into groups of, say, eight, and as far as possible on the same level. A series of lectures is given, supplemented by individual work. The group discuss the subject-matter of the lectures, but only within the group. It is claimed that this impersonal approach helps patients to make a personal application of various psychological mechanisms. The doctor, of course, occupies a father-figure position and regards the ensuing rivalries as useful. Furthermore, patient to patient transferences can be utilized to reduce the transference attitude of dependence on the physician.

In studying these various techniques of superficial psychotherapy it is noteworthy that some (e.g. McLaughlin) invite a father-transference situation and utilize it for suggestive and persuasive ends, while others (e.g. Wender and Snowden) limit or evade the transference situation by the group technique. This utilization of Freudian theory without recourse to psycho-analytical technique is stressed by Rickman (1939), who points out how much advantage the general practitioner can gain by interpreting the psychosomatic factor in disability in terms of Freudian theory. Again Wolfe (1939) emphasizes the benefit to all concerned which can accrue by the general use of a psychotherapist in conjunction with the surgeon or physician directly responsible. He would not limit the work of the psychotherapist to accepted psychosomatic disorders, but would assign him an essential role in the cure of all patients. Daniels (1940) takes a similar line to Rickman in relation to psychosomatic disorders in general practice.

Perhaps the most ambitious of the group techniques is that of Bierer (1942). He describes his system as applied to a series of 70 cases in a mental hospital. He claims that of those not discharged so far only four had a bad prognosis. In his system he combines direct psychotherapy, organized social activities and occupational therapy. The personal approach is a modified Adlerian one. The emphasis is on the patient's "general attitude," rather than on his need for insight. Early memories are reviewed with the object of illuminating the "general attitude." Bierer divides his patients into three categories which correspond roughly to Adler's sex, society and work. He then proceeds to deal with the main line of maladjustment. So far from utilizing the Freudian transference he replaces it by an "aim-transference." This is reinforced by an attempt to subject the patient to an "aim-experience" or an actual experience of success in thwarted individuals. It is to be noted that many psychotherapists and other physicians too have resorted to methods of this practical character in the process of "socializing" their patients. The Freudian school has in general deprecated such methods on theoretical grounds. Others have deprecated them because of the obvious difficulty of discriminating between the frustrations that can suitably be dealt with by an "aim-experience" and those which cannot be so dealt with. For instance it must be obvious that with many patients the most immediate desire or need must be for a sexual experience; obvious ethical problems present themselves at once. However, Dr. Bierer makes it clear that what he calls "situational treatment" comprises *impersonal* methods devised by the psychotherapist and his assistants, based on an analytical diagnosis shared by the staff but not known to the patient. It follows therefore that ordinary occupational therapy as provided by the

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hospital is merely "institutional" treatment as opposed to this "situational" treatment. The technique of situational treatment includes a club, study circles, concerts, etc.

Another method of environmental treatment based on superficial psychotherapy is that of Maxwell Jones (1942), who has developed it in the treatment of effort syndrome cases. To combat the fixed idea of heart-disease, the author began by giving a series of group talks in the presence of the nurses. These were not very effective. Theoretical knowledge of the structure and function of the nervous system had little therapeutic effect. Then the direction of treatment was turned to the patients' affective attitude, and talks with nurses, specially coached for the purpose, were instituted. In this way improved results were obtained.

Carver (1942), in referring to the affective attitude, points out that the present war has shown up, not so much conflict between self-preservative and patriotic ideals, as the complacent acceptance of entirely selfish standards. He suggests that the need for psychotherapy emanates from imperfect education and attenuated ethics.

Maclay and Whitby (1942) claim that 76 per cent. of their "war injury" civilians were enabled to return to work by persuasion, suggestion, re-education and explanation.

At a symposium devoted to "Direct Psychotherapy in Adolescence" the following therapeutic principles were laid down:

(1) The formation of a strong, positive transference.
(2) Direct discussion of difficulties with explanation of their significance.
(3) Some adjustment of environment.
(4) No strict analytical treatment.

Perhaps the most important contribution to superficial psychotherapy that has appeared in the period under review is Stekel's work (1940). This fertile writer produced his most important book in 1940 only a year before his death. It is called *Technique of Analytical Psychotherapy*. In it he lays down in uncompromising terms his acceptance or repudiation of the main Freudian tenets. As a seceder from the Freudian school his work is less known than it deserves to be. The following excerpts from the preface give a clue to the line he adopts:

"It was reserved for Freud to patent . . . his brilliant discovery, and to establish an iron-bound system of analysis. . . . Psychoanalysts will often analyse into their patients things which have no relation to or bearing upon the latter's fundamental troubles. . . . We must at length admit that the patient is an actor, playing to himself as well as to us, and that he may be able to outwit us. . . . After 30 years' experience of analysis, I no longer believe in the overwhelming significance of the unconscious. . . . Such analysts fail to recognize the nature of the spiritual conflict from which the patient suffers. . . . The discovery of all these things is work for an intuitive artist, endowed with imaginative insight which will enable him to feel his way into what may be the extremely complicated psyche of his patient. . . . Within a couple of months I can always discover whether the analy-

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sand's desire for illness exceeds his desire for health. . . . Analysts must adapt themselves to the idea of short periods of treatment. But will they be able to do so? Non-medical analysts are in even greater peril. Freud has thrown the weight of his authority in favour of 'lay analysis.' He should not have done so. . . . The danger of analysis lies in the 'transference.' . . . Orthodox Freudian analysis will not endure. . . . Freud himself has begun the retreat in respect of the anxiety problem. . . . A science in which the Master's utterances have become dogma is more of the nature of religion or sectarianism than of science and is doomed to destruction. . . . The medical analysis of to-morrow will have to . . . establish an undogmatic, unprejudiced psychoanalysis."

The observant reader will have noted that while Stekel demands the "establishment of a science," he simultaneously claims that the analyst must be an intuitive artist. To be consistent Stekel should admit that psychotherapy is partly a science, partly an art, while the Freudians, to be equally consistent, should discount entirely (as some do) the intuitive or artistic factor in analysis.

In another passage we read: "Every individual works by his own lights and in accordance with the inner laws of his own being. Psychoanalysis is a question of individuality and temperament. When I formulate rules that are to decide the analyst's behaviour, it is on the supposition that these rules can be adapted alike to his individuality and temperament and to the character of his patient."

Stekel has introduced a number of neologisms which have met with small acceptance in the psychiatric world. Nevertheless some of them have connotative value. For instance he discards the term "neurosis" as indicating functional nervous disorder on the ground that the conditions treated by the analyst pertain to emotions and not to nerves. He has coined the unattractive word "parapathy." Psychiatrists show no disposition to accept this ill-sounding word in spite of its etymological accuracy. For repression he substitutes "scotomization"—again an unpopular novelty. And there are others. Stekel departs from Freud in his conception of the unconscious in that he uses the term to cover the preconscious as well. It follows therefore that his use of the term "complex" is radically different to that of Freud.

Stekel claims that, as opposed to the passive treatment by free-association, his method is active. By this he means that the analyst maintains the initiative in much the same way as Adler. There is an authoritative or didactic note entirely alien to the therapeutic detachment of the Freudian analyst. Stekel has taken Adler's favourite concept of the patient's "life-line" and turned it into the "life-lie." And when one reads one case-history after another one begins to sympathize with Stekel. The fact seems to be that Stekel's clinical material differed from average clinical material in this country. Stekel's cases, with few exceptions, seem to have been implicated in gross sexual abnormalities or misdemeanours which they resolved to keep back from the analyst. Consequently we have this sort of pronouncement: "An analyst requires the skill of a physician, a detective and a diplomatist rolled into one" (p. 253). Or again: "Day after day I attack the patient's 'system' by storm, showing that he can get well betwixt night and morning, if only he will discard

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his fictive aims" (p. 315). But the "system" Stekel attacks seems seldom to be a matter of real repression and complex formation. "All cases have recent conscious conflicts." Indeed Stekel seems to be dealing generally with superficial ethical conflicts in which his detective methods are in constant play. So fundamental a departure from strict Freudian technique can only be justified in the light of results. And by this criterion it would seem that a case has been made out. After all there are only three main lines of departure from psychoanalytic technique if we are to find a short cut that gives satisfactory results both in speed and permanence. One is by hypnotic or narcotic exploration of repressed material. A second is by social readjustment without serious analysis. A third is by "attacking" the patient's mental background as was advocated by Adler and much more fully carried out by Stekel. It is perhaps permissible to predict that the super-psychotherapist of the future will be equally at home with all available methods, and will exercise such unerring diagnostic insight that he will apply in each case the method best suited to it. Certainly the time has come for psychotherapists to cultivate many techniques rather than a single one rigidly applied to every case.

The protagonists of deep psychotherapy are obviously at a disadvantage in a period which is largely influenced by war conditions. As one of us (H. C.-M. 1939) pointed out, the responsibility laid on the medical services, including the E.M.S., was to restore the patient to the *status quo ante bellum*. To embark on deep psychotherapy is to aim at a greater degree of adaptation than has previously characterized the personality. Debenham, Hill, Sargant and Slater (1940) hold strongly that "a neurotic cannot be freed of his neurotic tendencies." They therefore consider that radical psychotherapy is out of the question. Their object is to remove symptoms and to re-adapt the patient to a useful life within the army if possible, otherwise in civilian life. Dillon (1941) deprecates such therapeutic defeatism. Wright (1941) points out that deep psychotherapy is not applicable because the type of case most commonly met with is one who has always avoided occasions of adventure, danger and anxiety. These fitted themselves into civil life, but have nothing on which to construct a proper war adjustment. On the other hand, Burns (1942) points out that he is dealing with the neurotics weeded out of the army who are certainly not adapted to civilian life. The army is letting loose a body of disgruntled neurotics who ought to receive proper treatment.

This discussion opens up the whole broad cultural question of the value of deep analysis and (perhaps more important) its availability. There are, however, many indications in the literature that those who value analytical theory most are—perhaps belatedly—facing the demand for abbreviated technique.

As opposed to the defeatist views of some authors quoted above, we have the optimistic outlook of Wieninger (1938), who considers psychotherapy essential for patients recovering from a schizoid incident or a manic-depressive episode. He relies on psychotherapy to restore insight. To this end he initiates psychotherapy during the acute stage with the object of forming a positive contact between patient and physician. On this he builds later such analytical therapy as is possible. He emphasizes the need of the recovering psychotic for just that interpersonal relationship which he has lost.

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Mosse (1940) describes a technique of deep analysis which is claimed to achieve success in a shorter course. He uses spontaneous paintings afterwards analysed by free association. It is said that the method lessens resistances.

The most startling innovation in environmental treatment has been elicited by the large-scale effects of air-raids. McLaughlin and Miller (1941) describe a method of deconditioning anxious and hypersensivive patients to air-raid noises. Gramophone records are utilized—sirens, A.A. gunfire, dive-bombers, etc. The patient is subjected to several repetitions of these sounds. The responses of pulse-rate, respiration, etc., are noted. After the first session the improving record is shown to the patient with explanations and reassurance. The method can be used to induce abreaction. Good results are claimed after relatively short courses.

Hardcastle (1941) and Mackwood (1941) express approval of the treatment, but Dillon (1941) and Hurst (1941) demur. Dillon compares the procedure to a medicine-man beating a tom-tom. Hurst emphasizes the satisfactory results obtained at Seale Hayne in the last war by simple persuasion and suggestion.

Mira (1939) points out that all neurotic cases gravitate towards the more comfortable environment—soldiers to hospital, civilians to their homes. Mira's approach is in terms of psychiatric classification and disposal to a different environment. It is therefore easy to understand that he has seen no benefit accrue from systematic psychotherapy—indeed he regards it as dangerous because among soldiers it appeared to induce epidemics of psychoneurosis.

The adjuvant use of environment by many psychiatrists, quoted in other sections of this article, should be borne in mind.

Perhaps the outstanding novelty in psychotherapy that has appeared in the last five years is the use of barbiturates for purposes of mental analysis and abreaction. It is to be noted that the use of " veracity drugs " had already been common for some years in Russia as a juridical method of extracting evidence. Sodium amytal was used in America for purposes of narco-analysis as far back as 1929. Horsley was probably the first to make use of the method in this country (1936). Since that time many writers have advocated this method, especially during the war years. The principle is not a novel one, in that many drugs, from alcohol upwards, have been known for centuries to eliminate inhibition and to promote emotional expression. Various forms of barbiturates are in use, notably sodium amytal, evipan and pentothal sodium. Narco-analysis has to a certain extent replaced the practice of hypnoanalysis, made familiar in the last war by Hadfield, William Brown and others. In a leading article in the *British Medical Journal* (1942) it is pointed out that certain advantages, notably the impersonal approach, are in favour of narcoanalysis. It is further pointed out that narcoanalysis obviates the filial-parental relationship attributed by the psychoanalytical school to all hypnotic procedure.

Sargant and Russell Fraser (1938) have suggested a variation of hypnoanalysis by utilizing the transitory impairment of consciousness that is induced by hyper-ventilation. This method has been known in the East for centuries in connection with Yogi practices.

Reitman (1942) recommends the use of sodium amytal on one occasion only. He gives a sub-hypnotic dose and prefers to postpone the session until some

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preliminary psychological interviews have been held. He is thus able to direct more fully the course of the narcoanalytic session. He compares the method favourably with hypnoanalysis, especially for the treatment of amnesias. Blyth (1942) also stresses the advantage of the impersonal approach afforded by narcoanalysis. He uses pentothal sodium, and usually administers a preliminary dose of morphia. He describes two types of reaction:

(1) Droning and reluctantly answering questions.

(2) Spontaneous garrulity.

Since he regards the therapeutic objective as reintegration of dissociations, he considers it essential to work over the material with the patient in a subsequent ordinary session. Blyth claims very satisfactory results in effort syndrome. He also uses it for puerperal psychoses, depressions and schizophrenia. Sargant and Slater (1940) approve of the use of sodium amytal for the purpose of recovering lost memories. They used this in a number of men evacuated from Dunkirk with good results. They emphasize the merciful character of the treatment when the memories in question are intolerably painful.

Before the war Stungo (1938) had described his variant of the technique. Using evipan he aims at maintaining a pre-anaesthetic state by spreading out the administration over a lengthy period. This is to be contrasted with the technique of using the post-anaesthetic state for the same purpose. Apart from the patience required on the part of the physician for Stungo's method, another difficulty arises in the necessity for having a third person present to take notes. In a more recent communication (1941) Stungo professes to use both pre-anaesthetic and post-anaesthetic states according to the type of case. Like others, he considers it desirable to work over the material so collected in another session of ordinary psychotherapy. Stungo goes the length of claiming that failure to find the psychogenic factor by this method excludes functional disorder. He makes free use of this method for out-patient purposes, stating that the patient is fit to leave in two to three hours.

While many workers stress the impersonal factor in narco-analysis, Dicks (1940) considers that a good *rapport* is necessary. He finds the method has limitations both in overcoming resistance and in promoting abreaction. Felix Brown (1941) recommends evipan narcosis for those air-raid casualties in which hysteria has been produced or old hysteric reactions awakened. Wilde (1942), using pentothal sodium in a series of 50 military cases, claims that 33 were rendered fit to return to duty, 17 were invalided out, and of these half to a satisfactory civil life. He prefers the pre-anaesthetic method after a trial of both. He stresses a point that few writers refer to, namely, the value of the procedure for the diagnosis of borderline psychoses, mental deficiency and epilepsy, and also for the detection of simulation and malingering.

Horsley (1942) recommends narcoanalysis for producing *rapport* in a previously apathetic patient. Burns (1942) compares the condition produced to that which follows many cocktails—the patient is ready to give himself away. Clegg (1942) disapproves on the grounds that no repressed material is elicited by narcoanalysis. He prefers hypnoanalysis, particularly with soldiers whom he regards as good subjects. He considers that narcoanalysis is liable to interfere with the *rapport*, and that the patient is liable to repudiate at a

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subsequent interview the material elicited. He does not complain of this experience with hypnoanalysis, but there are some psychotherapists with experience of both methods who would consider such an eventuality as probable in the one procedure as in the other.

Another method that is referred to more or less casually by several writers is prolonged narcosis. This comes under the heading of psychophysical methods. It is a very old method, and in its early form was advocated by McLeod (1908) for the cure of drug addictions. But the bromides which were used originally proved too toxic for the desired duration of the narcosis. However, with the introduction of certain much less toxic barbiturates the method came into vogue again. Soneryl is used by many workers with satisfactory results. It is administered in the form of gr. iij suppositories. The maximum dose in 24 hours is about gr. xviij. The narcosis may be maintained for as much as 14 days. This is a useful technique for acute anxiety cases which are otherwise inaccessible.

This war is unquestionably the first in which the emotions of the civil population have been subjected to demands so similar to those experienced by the armed forces. And yet there is an essential difference generally present —namely, that the soldier can, at least indirectly, retaliate, whereas the civilian cannot. It would follow from this fact, at least on theoretical grounds, that the proportion of anxiety cases developed by civilians would be in excess of that manifested in the forces. It would be hard to establish such a result owing to the wide incidence of bombing raids. On the other hand, what can be established is that among civilians, anxiety and other psychoneurotic manifestations resulted in greater measure from the secondary effects of war than from direct experience of bombing. By " secondary effects " are meant evacuation, family separation, economic strain and occupational problems. Accordingly we find somewhat different conclusions reached by psychotherapists dealing only with civilians and those reached by observers concerned with military, naval and Air Force personnel.

Pegge (1940) describes a regular technique for civilian air-raid casualties. If the patient was unconscious he treated him as hypnotized on the assumption that even in an apparently unconscious state, suggestions could be heard and registered. In every case the traumatic experience was recapitulated in detail. Sedatives were administered, and at the end of three days the patient was either returned to his home or evacuated to a base hospital. Wilson (1940) depends on reassurance and persuasion reinforced by drugs. Dicks (1940) reported good results from abreaction, especially under evipan. Cuthbert (1941) describes a type of civilian case that passes into chronicity for want of any psychotherapeutic help.

It is clear from the above rather contradictory views that no agreed procedure can be expected when psychotherapists are working under the stress of occupational and environmental pressure. The reactions of a soldier discharged differ from those of a soldier who anticipates return to his unit ; the reactions of a civilian in an exposed area differ from those of one in an evacuation area ; the reactions of anyone with a safe home in the background differ from those of the homeless and the indigent.

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ARTERIOSCLEROTIC, SENILE AND PRESENILE PSYCHOSES.

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MEDICINE has lately become conscious of the special problems set by the increase of life expectancy following the hygienic progress of the last half century. General interest has been roused in the modification of diseases when they occur in the middle-aged and elderly, and in the illnesses typical of the later periods of life. From this movement psychiatry has profited in so far as many problems of "geriatrics" prove to be psychological and psychiatric problems. Our knowledge of facts has been confirmed and widened and the contact with general medicine should prove fruitful (Malamud, 1941).

It seems, however, doubtful if the psychiatric implications are adequately dealt with in the latest edition of the American standard work, Cowdry's *Problems of Ageing* (1942). Among many contributors there is only one psychiatrist, G. V. Hamilton, writing on changes in personality and on psychosexual phenomena. Of the two contributing psychologists Miles provides a full survey of the results of experimental psychology in the different stages of human life, and Lawton gives psychological guidance for older persons based on recent investigations. Psychiatry of old age is included in the chapter on "ageing of the nervous system" by Critchley, who only briefly touches on the medical and social problems of the subject.

1. MODIFICATIONS OF PSYCHIATRIC ILLNESS IN THE AGEING.

Psychoneuroses and "functional psychoses" observed in 110 patients over 45 were the material on which a study on psychopathology of the ageing by Diethelm and Rockwell (1943) was based. Their positive findings are well-known facts: Anxiety, depressive and paranoid reactions are the predominant types of illness; confusion, peevishness, resentment and apathy are frequent features in all these types; narrowness of interests, lack of plasticity, rigidity of the ageing personality and feelings of insecurity are the main underlying mechanisms. "Dissociative" schizophrenia was rare except as an exacerbation of an old schizophrenic illness. Hysterical symptoms took the form of dramatic emotional reactions coloured by anxiety. Manic states were not uncommon. Ageing frequently "unveils" constitutional personality traits. It is interesting that the authors find it necessary to point to the frequency of cerebral arteriosclerosis as a causative factor even in a material from which organic cases were deliberately excluded!

Doty (1942), describing 25 patients with manic-depressive psychoses occurring for the first time in later life, found signs of arteriosclerosis in over half of his cases. As he excluded involutional melancholia from his group, he found anxiety an uncommon symptom.

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A clinical and pathological survey of the types of chorea occurring in aged people by Pauly (1939) contains much detailed observation. Later cases of Huntington's chorea are not rare, but the most frequent cause is softening or haemorrhage due to cerebral arteriopathy localized in the basal ganglia and their connecting pathways.

Syphilis in old age was investigated by Hilliard and Kirman (1941) among the patients of a hospital for seniles, all over 70. One tenth of 700 admissions had a positive Wassermann reaction in the blood, and 12·5 per cent. of the positives had abnormal reactions in the C.S.F. Clinical symptoms of the latter, which were obviously due to cerebral syphilis, did not differ from those of the rest in which the presence of syphilis—as proved by positive blood Wassermann—was coincidental. This affirms the well-known difficulty of diagnosing G.P.I. in the elderly. The frequency of syphilitic infection in survivors of the generation born before 1870 was approximately the same in non-psychotics tested by Raybaud and Orsini (1939) in France (14 per cent. positive blood Wassermann).

The difficulty in diagnosing a brain tumour in the ageing and of differentiating its symptoms from vascular disease has been restated in two articles. The average age of 25 cases in which a clinically undiagnosed tumour was discovered at autopsy was 56 (Hastings, 1939). Typical symptoms, such as headache, vomiting, and choked disc were absent in more than two-thirds of the cases which were patients of a general hospital. Even in the Mayo Clinic the diagnosis had been missed in 40 out of 100 tumour cases confirmed by Moersch and his collaborators post mortem (1941). Only one-third of their patients had papilloedema; only 15 complained of headache. On the other hand, signs of mental change or deterioration of more or less severe type were a prominent complaint, usually reported by the patient's relatives.

2. Arteriosclerotic and Senile Psychoses.

Attention was directed to the circulatory factor in mental illness not only because of the greater frequency of arteriosclerotic psychoses with increasing longevity—the number of such cases in the New York State Hospitals was five times greater in 1936 than in 1912 (Clow, 1940)—but also because of the role psychological factors are supposed to play in causation and treatment of hypertension. Some of the recent work on this psychosomatic problem has a bearing on our topic. In a symposium on hypertension Katz and Leiter (1939) discussed the possible psychological influence of Western civilization on the incidence of hypertensive illness. Collaboration of psychiatry and general medicine is suggested in this field. The relation between blood pressure and emotional tension is the subject of two psychoanalytical case studies (Alexander, 1939; Saul, 1939). In cases of essential hypertension Saul established a condition of "strong, chronic hostility," inhibited, but near to consciousness. Similar views are put forward in an article by Riemer (1941). A series of 193 depressive and paranoid patients could be divided into three groups according to the strength of "inhibited aggressiveness" they displayed (Miller, 1939). When their blood pressure was tested its height was significantly correlated with the degree of hostile emotion.

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However important the psychological approach in general medicine may be, there is much doubt if progress can be achieved by such pseudo-quantitative methods applied to unconscious or semi-conscious emotions. Winding up the symposium, Weiss (1939) surveyed the various therapeutic approaches to hypertension, and pointed out the pitfalls as well as the achievements of the psychological method.

S. K. Robinson (1940) made a plea for medical and psychological treatment of hypertension, based on 93 cases, of which 70 responded well to conservative therapy; his paper is also an attack against operations like splanchnic resection, adrenalectomy, etc., applied to relieve hypertension. Good results after surgical procedure are probably explained by indirect mechanisms, such as shock, bed rest, or psychogenic factors, according to Robinson.

A comprehensive study of the brain in malignant hypertension (Rosenberg, 1940) disclosed severely destructive cerebral lesions in 12 out of 17 cases examined post mortem. Cerebral oedema, multiple miliary haemorrhages and infarcts as well as larger destructive lesions were found, obviously the result of profound changes in the arterioles of the brain. In the past many of the clinical phenomena in these patients were attributed to spasms of cerebral vessels. "These spasms may . . . occur and perhaps are responsible. . . . However . . . such an assumption may lead the clinician to an unjustified sense of security concerning the brain. A history of cerebral symptoms was found to be associated constantly with more or less widespread cerebral destruction." The problem of hypertension—angiospasm—haemorrhage is discussed in all its theoretical aspects in a paper by Scheinker (1940).

One hundred arteriosclerotic psychoses diagnosed clinically have been collected by Clow. Their medium age was 64, the ratio of males to females 1·2 to 1, which corresponds to the average sex incidence found by former workers. There was a marked family background of cardiovascular and senile disease, but manic-depressive heredity and depressive attacks in the patients themselves were also frequent. Alcohol and tobacco seemed without aetiological importance, but excessive taking of sedatives was admitted or suspected in many patients. Precipitating emotional causes were elicited in three-fourths of the patients. Hypertension was found in 79, retinal arteriosclerosis in 76 cases. The most frequent presenting symptom was delirium. More than half of the patients had vascular accidents and signs of focal cerebral lesions. These cases were treated according to the principles of general medicine, with emphasis on psychological re-adjustment through routine exercises and occupational therapy. Almost half of them returned home.

The idea that delirious states in old age are of toxic nature and often due to barbiturates or bromides given for insomnia has been taken up with great zest by G. W. Robinson (1939, 1941, 1942). From favourable results he obtained, using daily infusions of 10 per cent. glucose, he draws far-reaching conclusions about the pathology of the condition based on relatively little factual evidence.

Rothschild's neuropathological study of arteriosclerotic psychoses (1942) dealt with 28 cases in which the clinical diagnosis was confirmed post

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mortem and the brain fully examined. Although various focal lesions were found in all cases, there were many discrepancies between the extent of damage and the degree of intellectual deterioration. Structural damage, for instance, in patients with severe intellectual impairment was sometimes less pronounced than that observed in better preserved patients. As differences in localization of the cerebral lesions could, according to Rothschild, not account for these divergencies, he proposed an explanation which he had used before for a similar problem in senile dementia (1937). Taking the cardiac weight as a measurement of cardiovascular equipment and resistance, he found that it differed considerably among the patients. It might be expected that those with stronger resistance were able to compensate for even severe cerebral lesions, while those less well equipped showed severe symptoms, even after small damage. His figures bore out this theory; but it seems difficult to follow him further when he eventually linked up cardiovascular with psychological resistance of the personality, thus paying his tribute to the "psychobiological" trend in present-day American psychiatry.

Greenfield (1938) proposed a relatively simple classification of the pathological findings in cerebral vascular disease intended to replace the numerous variants distinguished by former workers: (1) All cases with softenings and haemorrhages, the most common form, localized cortically or subcortically, often with arteriosclerotic changes of the basal arteries. (2) Verrucose or granular atrophy of the cortex, usually associated with a similar change in the cortex of the kidneys and hyperpiesis. Both cells and fibres of the cortex are degenerated and replaced by neuroglial overgrowth. (3) Widely scattered areas of degeneration or rarefaction of nerve cells with little glial reaction. These so-called "areas of paling" are invisible to the naked eye, brain substance and vessels appearing normal until examined microscopically. This type is according to Greenfield closely allied to findings in mental deterioration associated with epilepsy.

A statistical survey of psychotic manifestations in 1,000 cases of acute cerebral vascular lesions confirmed at autopsy was published by Irish (1940, 1941). Only 17 per cent. of these patients afflicted by embolism, thrombosis or haemorrhage of the brain showed marked psychotic symptoms, including signs of mental deterioration. This figure can only be regarded as a minimum, since psychiatric symptoms are so frequently passed by in general hospitals, especially in elderly patients.

Our knowledge of the pathology of senile psychoses and dementia has made little progress in the last five years. E. D. Cameron, who put forward a research programme in this field at a round table discussion in 1941, has attacked it from many aspects, together with his collaborators. He confirmed the low ascorbic acid level in blood and spinal fluid of seniles established by Plaut and Bülow, and found that it could be raised by addition of sufficient vitamin C to the diet (Remp, Rosen, Ziegler and Cameron, 1940). The controversial nature of these findings is discussed by Mueller-Deham (in Cowdry, 1942). Cerebral oxygen consumption was found diminished in senile psychoses (Cameron, Himwich, Rosen and Fazekas, 1940). In both papers one misses control experiments in non-psychotic seniles. Greatly increased tendencies

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perseverate during the intake of memorized material and to elaborate it afterwards were found in psychological experiments; the poverty of recent memory in senile patients could be explained from these anomalies (Cameron, 1940).

Nocturnal delirium of seniles was reproduced when the patients were placed in a dark room during daytime. Thirteen out of 16 patients showed a severe distortion of their spatial image within an hour after they had been blindfolded. Cameron (1941) suggested that the delirium was based upon an inability to maintain a spatial image without repeated visualization.

Horgrefe (1939) tried to differentiate the various shapes and forms of senile plaques in the brains of five patients, and to relate the histopathological picture to the stage of development and to the clinical course of the mental deterioration in each case. Such attempts to differentiate certain types within the large and varied group of senile dementias are very much in line with the ideas of Kraepelin, who, for instance, separated clinically the hyperactive, lively and socially well-preserved cases with marked retention defect from the rest under the term "presbyophrenia." Bostroem explained the hyperactivity and sociability of the prebyophrenics as due to a previous hyperthymic personality. Against this view Sabass (1939) showed that it is impossible to predict the type of senile psychosis from the premorbid personality.

Tompkins (1939) collected data on the frequency of convulsions and other epileptiform signs in senile and arteriosclerotic patients. He found epileptic fits in 7, episodic attacks which might be epileptoid in 6, and lasting changes of consciousness in 3 out of 100 cases.

Cameron (1941) has emphasized the part played by loneliness and lack of social contact in the causation of breakdown in the elderly; he opened a series of social clubs in connection with a special clinic to overcome their social isolation. The idea of lack of social integration as a factor in senile psychoses is supported by a study by Williams and his co-workers (1942) on the significance of what they called extrinsic factors in seniles and arteriosclerotics. They went into the histories of 47 carefully diagnosed cases of each group and contrasted the social settings prior to the onset of illness. 79 per cent. of the arteriosclerotics lived with their wives or children in favourable social conditions against only 15 per cent. of the seniles. Only 21 per cent. of the latter lived under financial circumstances which could be regarded as satisfactory, while 68 per cent. of the arteriosclerotics had had financial security. The authors appeal for "well conducted, socially acceptable institutions for the aged" as a preventive measure against senile psychoses.

That it is still worth while trying to distinguish senile from arteriosclerotic psychoses clinically was proved by Rothschild (1941) in a critical paper on differential diagnosis. He compared the symptoms and the post-mortem findings in 60 patients, half of which were clinically diagnosed seniles and the other half arteriosclerotics. Although anatomically pure forms of each were less frequent than mixtures of the two processes, one or the other predominated in most cases; and clinical pictures of a mixed nature were not nearly as frequent as might have been anticipated from the pathological findings. The criteria generally used in clinical psychiatry were confirmed. Senile psychoses occur later in life, are gradually progressive and last longer; paranoid pictures

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are more common in seniles. Arteriosclerotic psychoses have usually a sudden onset, show less intellectual impairment, more fluctuation of symptoms, transient neurological signs, etc. Rothschild also warned against labelling senile-arteriosclerotic any type of psychosis when it affects an elderly person, and gave striking illustrations of cases in which the diagnosis was disproved at autopsy.

3. Presenile Dementias.

This subject, which has attracted more workers than any other topic of the present chapter, has been admirably surveyed by McMenemey (1941). His article covers not only the "essential" dementias like Alzheimer's and Pick's diseases, but also deals with Huntington's chorea, Jakob's disease and the other rarer types in which neurological symptoms are predominant. The differential diagnosis of dementias of middle age due to tumour, trauma, syphilis, arteriosclerosis, are fully discussed, as well as Gower's concept of abiotrophy, frequently used as an explanation of senile and presenile disease and as a "cloak for ignorance." The concept is meant to signify an inborn constitutional tissue defect manifesting itself at a certain age of the individual.

Spatz (1938) has taken up this idea in a somewhat modified form. He speaks of premature ageing of certain cerebrospinal systems as the hypothetical cause of a number of diseases which he proposed to combine under the term "systemic atrophies." In such a group Pick's disease would be classed with Huntington's chorea, Jakob's disease, and with ponto-olivary, cerebellar, and spinal "degenerations" like spastic spinal paralysis and amyotrophic lateral sclerosis; Leber's hereditary optic atrophy was also considered as a probable member of the group. This fusion of hitherto unconnected disease entities is mainly based on pathological similarities; it would make it easier to account for the relatively frequent combination of symptoms from the different diseases in the same patient and for co-occurrence of different forms in the same families.

A. *Alzheimer's Disease.*

This is not included in the "systemic atrophies" by Spatz because its pathology is not atrophy of nervous elements alone, but also includes characteristic tissue reactions with formation of senile plaques and fibrillary changes. Also it is not confined to one neuronic system, and finally its hereditary nature is still under debate. However, combinations of Alzheimer's with other forms of the presenile group are not infrequent. Further instances of such mixtures have been published, e.g. Liebers, 1939—with Pick's disease; Worster-Drought and others, 1940, van Bogaert and others, 1940—with spastic paraplegia; Hemphill and Stengel, 1941—with cerebellar atrophy. While all these atypical cases show familial incidence, new familial cases of pure Alzheimer's disease have also been reported (Gruenthal and Wenger, 1939/40). On the other hand, nothing about heredity could be established in six patients by McMenemey (1940); in only one out of a series of seven cases collected by English (1942) was there heredity of the same type; and in nine patients recently communicated by Stengel (1943) the hereditary factor was found

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insignificant. One has however to remember the difficulties in assessing hereditary trends in elderly people who have often been lonely inmates of homes and hospitals for many years. A completely unexplained feature of Alzheimer's disease is the prevalence of females. All patients of McMenemey's and English's series were women, as also seven out of the nine cases in Stengel's material.

The cerebral changes in Alzheimer's disease are so characteristic that it was suggested (McMenemey, 1940) that the diagnosis be based on pathological findings only, thus including rare cases starting in adult life and without the typical clinical symptoms. Unfortunately the characteristic changes—plaques and neurofibrillary alterations—are also present in ordinary senile dementia, the only distinctive sign being a greater degree of severity in the findings in Alzheimer's disease. Surveying the literature on early cases, Ferraro and Jervis contributed two observations with autopsies of patients whose illness started at 33 and 38 respectively. Their clinical symptoms and course were those typical of Alzheimer's disease. From the newly published series of cases mentioned before, these symptoms seem well established. The most prominent are, in the approximate order of their appearance, impairment of memory, prolonged periods of restlessness, anxiety and depression, speech disorders, syncopal and epileptic attacks, muscular hypertonicity, and focal signs like apraxia, agnosia, cortical blindness, facial paresis, etc. (Rothschild, 1934; English, 1940). The significance of restlessness and over-activity and of the emotional features was fully discussed by Stengel (1943). The diffuse focal symptoms and the muscular rigidity have attracted less attention among recent workers. All this refers to cases in which the illness was already in a rather advanced stage because only then are they usually seen by a psychiatrist. Prodromal depressive or paranoid symptoms may disguise the organic nature of the disease; rapid deterioration occurs in typical cases, but arrests and remissions and a prolonged course over twenty years have been observed.

Differential diagnosis from senile dementia can be very difficult, especially if the patient approaches 60 at his first visit to a doctor. Absence of fabrication, greater intellectual deterioration and the presence of focal symptoms have a certain distinctive value. There are more signs of general senility in the senile, while in Alzheimer's disease only the central nervous system shows deterioration (English, 1940). Air encephalography shows dilatation of ventricles and general cortical atrophy, but only in relatively advanced cases. Electroencephalography was employed by Longridge (1939) and Stengel (1943); the former found a well-marked delta focus in one fronto-temporal region, while the latter's patient had "small irregular potential changes with no sign of any rhythmic activity whatever." Further observations are wanted before any conclusions are possible.

Differentiation from Pick's disease will be discussed later.

All workers in this field agree that Alzheimer's disease is not rare, and that many cases pass undiagnosed in mental homes for the elderly and in other institutions. It is certainly much more common than Pick's form of presenile dementia.

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B. *Pick's Disease.*

Workers in Britain and America have only lately paid more attention to this form of presenile dementia first described by Arnold Pick in 1892. By way of contrast there seems at present a tendency to over-estimate its frequency. The fact that according to Ferraro and Jervis (1940) some 50 publications had appeared in the continental literature within six years is somewhat misleading, because the great majority of these publications deal with one or two cases only.

As the name appears unfortunate because of possible confusion with Pick's polyserositis or Niemann-Pick disease, "idiopathic circumscribed presenile cerebral atrophy" has been suggested as a comprehensive and accurate term (Nichols and Weigner, 1938).

In spite of many instances in which no positive family history is reported, there is good reason to regard the hereditary factor in Pick's disease as important, perhaps even as satisfactorily established (Benedek and Lehoczky, 1939). Many recent case-studies deal with families in which an identical heredity is found, or more often, because of lacking autoptic evidence in relatives, suspected. Friedrich (1940) has proved the presence of Pick's disease in mother and son by post-mortem examination of the brains of both. Lowenberg, who had reported a number of typical cases before (1936), distinguished, in a recent article with Boyd and Salon (1939), two familial trends operating in Pick's disease, viz. occurrence of the same illness in near relatives, and the tendency of Pick's disease to appear in families with other degenerative changes of the central nervous system, e.g. senile psychoses, paralysis agitans, and mental deficiency. Related views of Spatz have been already mentioned (p. 321).

Pick's disease has a predilection for females similar to that of Alzheimer's. If Rothschild's (1938) assertion that it is twice as frequent in women as in men proves correct, this would be a theoretically and practically important distinction from cerebral arteriosclerosis, which has the opposite ratio of sex incidence. As in Alzheimer's disease the age incidence has extended more and more, the youngest case confirmed by autopsy being only 21 (Lowenberg, Boyd and Salon, 1939). Cases up to 80 have been reported. Cases of Alzheimer's disease reported in patients over 60 are somewhat doubtful because of the identity of its pathology with senile dementia.

Pick's original interpretation of the pathology as precocious ageing of association centres is still valid in spite of many attempts to supplement or replace it. The atrophy is systemic in so far as the gross macroscopically visible changes involve preferably the frontal lobes, but temporal, parieto-temporal and occipital forms have been observed; it is symmetrical, but often the left hemisphere is more affected. On histological examination atrophic areas, with corresponding glial reaction, are found all over the cortex, and in some cases in the basal ganglia and substantia nigra. Davison (1938) stressed the localization of atrophy around blood vessels, but Ferraro and Jervis (1940) who had favoured this idea before, could not confirm it in their recent case. In fact, as McMenemey (1941) points out, the cerebral vessels are singularly free from histological evidence of disease. The white matter of the hemispheres is always reduced—a fact much emphasized by Freeman and recently by Stengel (1943).

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The clinical picture is less uniform than that of Alzheimer's disease, as one would expect from the differing localization of the main atrophic region in different patients. Loss of judgment, reduction of associative power, emotional abnormalities like facile hilarity, flattening of affect and other personality changes precede the disturbance of memory, which in many cases was found surprisingly intact (Bouton, 1940; Malamud and Boyd, 1940). Disturbance of the waking-sleeping rhythm has been observed as an initial symptom. Disturbances of speech are prominent when the illness progresses, e.g. echolalia (Nichols and Weigner, 1938) and all types of aphasia, especially a complete sensory aphasia. In later stages there is loss of spontaneity, increasing apathy, and severe mental decline; the patient usually succumbs to some intercurrent infection. The duration varies between 2 and 12 years.

Diagnosis is often very difficult. "There is hardly any other syndrome in the field of neurology and psychopathology that represents such a testing ground for diagnostic acumen and is so instructive as that of the presenile dementias" (Bouton). While this worker published four cases only diagnosed post mortem, Urechia (1940/41) reported his case because it was diagnosed clinically. Ferraro and Jervis (1940), on the other hand, insist that half of the 50 patients from the European literature had been correctly diagnosed in lifetime.

As to differential diagnosis from Alzheimer s disease, Critchley (1938) remained sceptical about the possibility of distinguishing the two forms on purely clinical grounds; but on the same occasion he surveyed the fundamental ideas of Goldstein's method of examination, from which many workers expect much help in the analysis of the psychological disturbances in Pick's disease. Because of the small number of patients observed by one author, unfortunately no one has been able to compare Goldstein's method in a group of early cases belonging to Alzheimer's and Pick's forms. Convulsions and muscular rigidity are rare in Pick's disease; the focal symptoms are more diffuse in Alzheimer's, more definite in Pick's form; initial restlessness and depression are more frequent in Alzheimer cases. A resemblance between Pick's disease and general paralysis has been noticed as against a similarity of Alzheimer's to senile dementia (Nichols and Weigner, 1938). Early impairment of insight in Pick's disease forms a useful diagnostic sign of distinction from cerebral arteriosclerosis which, in contrast to the steady progressing decline in Pick's disease, usually shows considerable fluctuations. Diagnosis by air-encephalography is only possible in cases of severe localized atrophy, i.e. in a rather advanced stage of the illness. According to Romano and Miller (1940) the characteristic pneumo-encephalographic data are: "Bilateral dilatation of the lateral ventricles, increase of intragyral air spaces more marked in the frontal and temporal areas, and accumulations of air over these areas in the nature of confluent masses."

c. *Other Forms of Presenile Dementia.*

Jakob-Creutzfeld disease.

A few more instances of this type of presenile dementia, which is characterized by additional neurological signs, have been reported within the last five years, almost all of them with a slightly different clinical picture and correspond-

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ing different pathology. A. Meyer (1938) demonstrated two cases at a meeting of the Royal Society of Medicine, one of which showed a combination with amyotrophic lateral sclerosis. A patient in which the neurological symptoms were of the paralysis agitans type was subsumed under this group by Brown and Buckle (1939). Davison and Rabiner (1940) used Jakob's original name, "spastic pseudo-sclerosis," for their cases, because spastic paresis with pyramidal and extra-pyramidal features was a prominent symptom, while the mental changes were slight or appeared only in the later stages of the illness. After a thorough discussion of all possible classifications, Jervis and his collaborators (1942) found the clinical and pathological features of their patient well in keeping with Jakob's original description. Conversely, McMenemey and Pollock (1941), refrain from classifying their case, but emphasize its resemblance to the Jakob-Creutzfeld syndrome and to a modification of it first described by Hallervorden.

Kinneir Wilson (1940) criticized the term "spastic pseudo-sclerosis" as inaccurate and misleading. Cortico-pallido-spinal degeneration and similar hyphenated names have been suggested in which the terms can be exchanged according to the parts of the C.N.S. involved. Many workers favour retaining the names of the first observers on the grounds that it is still doubtful if the condition represents a nosological entity. In fact, it serves at present as a convenient "dumping ground" (McMenemey, 1941) for all instances of atypical presenile dementia combined with various neurological disturbances, especially of the motor system. The illness runs a rapid course, lasting 1–2 years. Its histology is a parenchymatous atrophy of nervous tissue in the affected regions with a more or less marked glial hyperplasia.

Relations to the so-called primary cerebellar atrophies are highly probable, especially in cases like those recently published by Akelaitis (1938), Richter (1940), Weber and Greenfield (1942), in which the cortex was involved and the patients showed mental deterioration in the presenile age.

Familial incidence is only reported in a few patients of the Jakob-Creutzfeld type. Several workers have discussed the similarity of the symptoms and pathology with those of pellagra. Vascular and infectious origins have also been debated.

Stern's (1939) patient with a bilateral symmetrical degeneration of the thalamus may be mentioned in this connection because he also showed a rapidly dementing course during the fourth decade. In other respects the observation differed from all known types of presenile illness.

Kraepelin's Disease.

Gruenthal, whose important work in the field of presenile dementia is generally recognized, suggested this name for atypical depressive psychoses with catatonic features starting after the age of 40 and followed by severe organic deterioration. The organic nature of these late catatonias had been pointed out by Kraepelin. Best (1940/41) contributed another example of this group examined in Gruenthal's laboratory. Histologically a severe affection of nerve cells in cortex, basal ganglia and cerebellum was found in the patient, who died from an accident.

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In conclusion it seems appropriate to remember that the "essential" presenile dementias form only a small percentage of the psychoses with intellectual deterioration of this age, and to quote, in a slightly modified form, the "working classification based on a clinico-aetiological foundation" of these psychoses as given by Critchley (1938):

Syphilitic dementias (including "syphilitic encephalitis," luetic cerebrovascular disease, G.P.I., etc.).

Arteriosclerotic dementias.

Traumatic dementias (including sequelae of cerebral laceration, subdural haematoma, etc.).

Cerebral tumour and abscess.

Epileptic dementias.

Dementias following chronic psychotic states like schizophrenia.

Dementias complicating chronic neurological disorders (disseminated sclerosis, epidemic encephalitis, subacute combined degeneration, Huntington's chorea.)

Dementias after chronic, toxi-infective states (uraemia, alcohol, lead, hashish, barbiturates, pellagra).

Essential dementias of unknown origin: Pick's, Alzheimer's, Jakob-Creutzfeld's disease, etc.

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PSYCHIATRIC ASPECTS OF HEAD INJURY.

By E. GUTTMANN, M.D.Munich, L.R.C.P.E.

IN the past head injuries have been of comparatively little concern to the psychiatrist. As judged from statistics of admission to mental hospitals they are a small problem. Mapother (1937), for example, who took a very broad view of the causal connection found in L.C.C. mental hospitials—3 per thousand in observation wards, 4 per thousand in psychiatric O.P. depts. in general hospitals, 7 per thousand of the admissions attributable to head injuries. The increasing interest that psychiatrists take in head injuries at present is mainly due to the increasing amount of extramural work that they are being called on to do. In general hospital and outpatient practice they are bound to encounter a considerable number of problems connected with head injuries, both in the acute and in the later stages. The psychiatrists and neuro-psychiatrists in the Services have probably had this experience first, but when adequate provision of psychiatric service becomes available in the general hospitals, many cases will come into the orbit of psychiatrists which hitherto have been " disposed of " without much regard for their mental aspect.

PATHOLOGY.

The morbid anatomy of cerebral injury in general is not the subject of this review. The reader can be referred to A. Meyer's chapter in this volume, and to the " General Pathological Considerations " by G. B. Hassin in Brock's recent book (1940) on *Injuries to the Brain and Spinal Cord.*

CLINICAL CLASSIFICATION.

The standard Nomenclature of Disease has the general heading " Psychosis due to trauma (traumatic psychosis) " with the following sub-headings :

Traumatic delirium.
Post-traumatic personality disorder.
Post-traumatic mental deterioration.
Other types (to be specified).

Considering this inadequate, Bowman and Blau (1939) propose the following classification :

A. Primary traumatic mental disorders (mental disorders due primarily to head trauma) :

1. *Acute.*
   Concussion syndrome.
   Traumatic coma.

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II. *Subacute.*

Traumatic delirium.
Traumatic Korsakoff.
Other types (to be specified), e.g. stupor, apathetic syndrome, twilight state, mixed.

III. *Chronic.*

Post-traumatic personality disorders:
(*a*) Of adults.
(*b*) Of children.
Post-traumatic mental defect conditions:
(*a*) Special (to be specified), e.g. memory, aphasia, alexia, amnesia.
(*b*) Generalized.

Mixed type.

Punch drunk.
With traumatic convulsion disorder.
Other types (to be specified).

B. Secondary mental disorders (mental disorders associated, precipitated, or complicated with trauma, but not due primarily to head trauma):

I. Psychoneurosis (type to be specified) with head trauma (e.g. conversion hysteria, anxiety state, terror neurosis, malingering, etc.).
II. Psychosis (to be specified) with head trauma (e.g. general paresis, psychosis due to alcohol, psychosis with cerebral arterio-sclerosis).
III. Mental deficiency (amentia) with head trauma.

Davidoff and Hoch (1940) classify the mental states caused by head trauma as follows:

(1) The acute stage.
(2) The subacute or Korsakoff type.
(3) The chronic state.
(4) The mixed type.

1 and 2 are also called post-concussion syndrome. The chronic states are divided into:

A. Post-traumatic mental deterioration or defect where organic factors predominate, and where the previous personality plays a relatively lesser role in the symptomatology.
B. Post-traumatic personality disorder. The previous personality is a relatively greater factor in determining the course.
C. The combined type.
D. Traumatic neurosis.

The personality disorders (*b*) are divided into the milder form—vaso-motor changes, lack of concentration, fatigue, emotional instability, unreliability and irritability—and the severe form with delusions and hallucinations, as well as definite antisocial and asocial behaviour. Digitized by Google

The Brain Injuries Committee of the Medical Research Council (1941) has issued a glossary of psychological terms commonly used in cases of head injury. Desirable as it seems to have a uniform terminology, the definitions proposed in several instances differ so much from the common usage of the terms employed that it must be feared they will not find general recognition. They will be quoted at the appropriate points in the following chapter. Symonds (1942) has given some useful explanations and comments.

SYMPTOMATOLOGY.

The psychiatric symptoms which develop after head injury are well known and can be found in text-books. Numerous articles published just before or at the beginning of the war reviewed them for the practitioner.

Symonds has given the most comprehensive and up-to-date description in Brock's monograph (1940). The Brain Injuries Committee of the M.R.C. made a valuable contribution by publishing definitions of the most commonly used terms, thus attempting to combat the well-known difficulties due to the use in psychiatry of an ill-defined nomenclature.

According to this glossary, "Concussion is a state of unconsciousness or impaired consciousness, however fleeting, suddenly produced by mechanical force applied to the skull, and usually followed by retrograde amnesia." This official definition, if accepted, will do away with the confusion arising from the fact that some used the word concussion for the mechanical act, instead of, or in addition to, the psychological effect. However, retrograde amnesia is not common in milder cases, and moreover it is difficult to assess owing to the circumstances of the accident. One would prefer "retrospective amnesia," and it might be suspected that it is this that was actually meant. In the glossary a state of absolute unconsciousness is called coma, and this is characterized by the absence of all psychologically understandable responses to stimuli or inner needs. In the absence of psychological response, the intensity of the disturbance (often called the depth of the coma) should be characterized by the presence or absence of neurological phenomena, such as swallowing, pupillary and corneal reflexes, plantar responses, etc (Glossary). Semi-coma describes a state in which psychologically understandable responses are elicited only by painful or other disagreeable stimuli. If one wants to be precise, the emphasis has to be on the "*psychologically understandable.*" Movements of limbs after pinprick need not have psychological meaning.

On recovering from unconsciousness the patient passes through a state of clouded consciousness (unless he wakes up suddenly). This state of clouded consciousness, unfortunately, is called confusion in the glossary.*

The glossary distinguishes three degrees of clouded consciousness: "Severe" describes a state in which the patient, though for the most part inaccessible, will occasionally show adequate response to simple commands forcibly given. "Moderate" signifies a state in which the patient, though out of touch with his surroundings, can be got to give relevant answers to simple questions. "Mild"

* This usage leads to formulations like the following: Prolonged confusion is common after severe closed head injury. . . . Associated injuries may lead to confusion in diagnosis (Ritchie Russell, 1942).

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finally is a state in which the patient, though presenting the characteristic features of confusion (i.e. clouded consciousness) to some degree, is capable of coherent conversation and appropriate behaviour. The general characteristics of clouded consciousness are " impaired capacity to think clearly and with the customary rapidity, and to perceive, respond to, and remember current stimuli ; there is also disorientation."

The glossary defines two other expressions which apply to the acute stage, viz. delirium and stupor. Traumatic delirium is a state of much disturbed consciousness with motor restlessness, transient hallucinations, disorientation, and perhaps delusions. The restlessness of the unconscious (comatose) state with its extra-pyramidal hyperkinesis and pseudospontaneous movements must be distinguished from the activities of the delirious patient who acts in keeping with his dreamlike mental experiences (Curran and Guttmann, 1943). Traumatic stupor, according to the glossary, is a state in which the patient, though not unconscious, exhibits little or no spontaneous activity. As in general psychiatric usage, stupor means absence or reduction of spontaneous activity not due to clouded consciousness (Curran and Guttmann, 1943), there seems to be little reason to describe the state in question otherwise than as aspontaneity or lack of initiative.

" Traumatic automatism," according to the glossary, is a state in which the patient, though capable of responding normally to his immediate environment, subsequently has amnesia for the period in question. In this state there is always some degree of confusion with disorientation. In other words, automatism is used to describe the mildest form of clouded consciousness. This usage was introduced by Symonds, who describes six stages of recovery from concussion, with automatism as the last. His description of the six stages may conveniently be given here :

Stage 1.—Complete paralysis of cerebral functions, which may extend for a moment to the vital centres.

Stage 2.—Coma. Flaccid paralysis, abolition of reflex function. Pulse and respiration have returned.

Stage 3.—Stupor. Reflex functions return ; one observes movements of simple purposeful type such as withdrawal of a limb from a painful stimulus. The patient may respond to forcible command, but is otherwise unconscious of his surroundings.

Stage 4.—Restless confusion ; the patient is resistive and often violent. Voluntary movements and speech return, but without control or direction.

Stage 5.—Mental confusion. The patient's behaviour is quieter and more controlled, his speech more coherent.

Stage 6.—Automatism. The patient responds naturally to simple questions and performs accustomed actions in an orderly and effective way. He is still dazed and imperfectly aware of his surroundings ; he repeats the same question. He has no memory of this phase in retrospect.

Symonds (in Brock, 1940) assumes that this same sequence of events is to be observed in a case in which the process of recovery occupies a period of days, and also in a case in which recovery is complete within a few minutes.

All these stages are covered by the retrospective (post-traumatic) amnesia, and, in Symonds' view, it is only the duration of these phases which varies with

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the severity of the " general contusional " effect. It is the logical outcome of this view to employ the duration of the amnesia as a measure of the severity of this effect. This, in fact, was proposed originally by Ritchie Russell (1938) in his classical paper on the exclusively practical consideration that it is easier and more reliable to assess amnesia than a disturbance of consciousness, regarded as equivalent to the memory gap. Although this theoretical assumption is debatable (the amnesia covers the Korsakoff stage of recovery, during which the patient may be quite lucid), the method of using the length of the post-traumatic amnesia as a measure of the severity of the injury has found wide practical application (Ritchie Russell, Symonds, H. Cairns, E. Guttmann, etc., etc.). It is practically the only one that lends itself to statistical comparison. It would be desirable to reach agreement about the classes to be used; most writers divide their cases into five groups: Post-traumatic amnesia up to five minutes (0); up to one hour (A); up to one day (B); up to one week (C); and longer (D); but other divisions are employed, and even the same writer is not always consistent in the use of these classes. There is agreement that " severity " in such comparisons refers to the general concussive effect only; the surgical severity of each case must be judged independently (laceration, compound fractures, cranial nerve injuries); and localized cerebral injury needs separate assessment. The general concussive effect of high-velocity impact on a small area of the skull is very small (for example, in gunshot wounds), and it is therefore not paradoxical that these cases would not appear to be " severe " if measured in terms of post-traumatic amnesia. The amnesia is a satisfactory measure of the " concussion," and therefore of practically all cases of blunt injury. But this method is a simplification for practical purposes; to be exact, each case of head injury should be assessed as cranial, local cerebral, and general concussive injury, to which may be added the psychological trauma and the social-economic significance.

For clinical psychiatric purposes, E. Guttmann (1942) suggests a simple classification. He suggests calling " mild " those cases which wake up without a transitional period of clouded consciousness, and " severe " those which pass through an amnesic-confabulatory (Korsakoff) stage. When the patient gradually wakes up, going through a stage of clouded consciousness only, he speaks of moderate severity. This classification is useful only for patients observed at the time, not in retrospect, and it does not assume that all cases necessarily pass through the same stages.

Little has been published on the psychology and psycho-pathology of the post-traumatic memory disturbances. Symonds (in Brock, 1940) has called attention to the shrinkage of the retrograde amnesia, and E. Guttmann (1942) has pointed out that this observation is important in regard to the theory of this puzzling phenomenon. Disturbance of recall at the time of assessment is one of the factors to account for an apparent gap in the past memory. It would seem preferable not to call amnesia the failure to recall recent events (such as observed in Korsakoff states, traumatic or otherwise), and to speak about retrograde amnesia only after the function of recall has settled down again. Post-traumatic amnesia only can be assessed in retrospect.

Delirious episodes may or may not occur during the recovery from severe

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head injury. Guttmann and Winterstein (1938) have pointed out that they are never observed after knock-outs in boxers. Curran and Guttmann (1943) attribute them to intercurrent infection, excessive loss of blood, respiratory or circulatory embarrassment, and the possible significance of a constitutional element or chronic intoxication is mentioned. Povitskaya (1942) points out that cerebral trauma sustained during alcoholic intoxication leads to greater restlessness and resistiveness, and this, as well as a history of chronic alcoholism, is clearly correlated statistically with a higher incidence of delirium, resembling delirium tremens. All mental symptoms are more highly coloured in alcoholic subjects; in non-alcoholics delirium is rare. Nightmares, horror, are almost a rule after concussion, irrespective of its seriousness.

Eichler (1939), on the other hand, described cases of Korsakoff psychosis with manic affect and grandiose ideas, combined with disturbance of pupillary reactions and absent tendon reflexes in which there were no predisposing factors such as alcoholism, or syphilis, and no demonstrable constitutional element.

T. C. Graves (1938) drew the attention to certain groups of cases of head injury followed by mental symptoms in which treatment of chronic infective processes (in the teeth, nasal sinuses) were followed by considerable improvement of mental symptoms.

The neurological symptoms and signs cannot be dealt with here, but a few borderline items may be quoted.

M. Scott (1940) demonstrated three cases of stupor following head injury due to a subdural collection of clear fluid—so-called subdural hygroma. After evacuation of the fluid the patients recovered. This type of lesion should be suspected in every case of head injury in which the normal tendency to recovery is not shown after proper measures for the relief of raised intracranial pressure and oedema. The treatment is opening by trephine or burr.

Bay (1939) pointed out the importance of olfactory examination, as anosmia is not infrequently the only objective sign of intracranial damage after head injury. Leigh (1943) encountered 72 cases with impaired sense of smell among 1,000 consecutive cases of head injury. This sign may follow violence to any part of the head, but frontal and occipital injuries are the most common. A head injury which causes defects of smell is generally a severe one.

E. Stier (1938) found loss of libido in 33 cases (? out of how many) of head injury of varying severity: in half of the cases—all over 40 years of age—there was also loss of potency. But Fleck (1939) pointed out that these disturbances of sexual functions occur only in cases of cerebral contusion, not in cases of simple concussion.

Witzelsucht does not occur in all frontal injuries (Bostroem, 1940). It has localizing diagnostic value only if it occurs within the framework of a changed personality. The latter usually consists in extraordinary levity with regard to all the problems of life, and excessive indifference towards the patient's own defect. The patient is incapable of "emotional orientation." The lack of spontaneity as observed after frontal injuries is often difficult to distinguish from psychically conditioned inhibition.

Headache is probably the most important symptom after head injury. Its

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omnipresence is generally taken for granted. However, E. Guttmann (1940*b*) who made a systematic study of its occurrence, found that less than 50 per cent. of his patients—a consecutive series of head injuries admitted to an accident ward—complained of headache when waking up from unconsciousness. Only 20 per cent. had headache when leaving hospital. Cases with short amnesia were more liable to complain of headache than those with long amnesia, and the age of the patients did not make much difference in the frequency. When followed up three and six months after the accident, only 20 per cent. of the patients complained of headache, mild or severe, and this figure included all headaches occurring in the follow-up period, some of which were probably due to other causes.

Rowbotham (1942) examined 500 cases suffering from the effects of injury to the head and found headache in 50 per cent. of them, but these cases were probably a selection of bad risks.

Dereux (1939) described the post-concussional syndrome as the "subjective syndrome." From varying authors he gathered figures about its frequency, varying between 95 and 50 per cent.

The syndrome of headache, giddiness and nervous instability (minor contusion syndrome) has, according to Symonds (in Brock, 1940), doubtless an organic basis. The symptoms constituting it are in the main symptoms of instability rather than loss of function, and they may occur, not only in the course of recovery from severe injury, but also as the more immediate effect of slight injury without disturbance of consciousness.

The onset of any or all of these symptoms may be delayed. After brief loss of consciousness, for example, the sufferer may appear to have completely recovered in a few hours, yet in the course of a few days may begin to complain of headache, giddiness, or undue fatigue of body and mind. Occasionally it may be a week or more after the accident before the patient seeks advice on account of such symptoms, and he may have continued at his work during this time. The same may be true in the case of a man who has not lost consciousness at all, but has sustained a bruise or laceration of his scalp. This latent interval has often been attributed unjustly to the effects of a compensation neurosis, but it is in fact observed quite commonly in cases where no such possibility exists.

Many of the patients who suffer from headache and giddiness complain also of symptoms which Symonds groups under the heading "Nervous instability." Most frequent is an undue liability to fatigue, both mental and physical. There may also be intolerance of noise and light (apart from the aggravation of headache by these causes); insomnia; anxiety; and depression. The patient's spontaneous complaint is usually that of nervousness. Doubtless these symptoms are partly, often largely, due to psychogenic causes. They cannot, however, always be ascribed to the memory of the accident, for that is often blotted out by the retrograde amnesia; nor, as Ritchie Russell (1932) has pointed out, are they by any means confined to compensation cases. They are most common in persons with a family and personal history containing evidence of neurotic predisposition, and are also dependent upon the degree of vexation and distress occasioned by the circumstances arising out of the

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accident. They are more apt to occur in elderly and arteriosclerotic than in young and healthy persons.

The patients who exhibit these symptoms of minor post-traumatic mental disorder may present no measurable evidence of organic damage. Formal tests of memory, power of calculation, or reaction-time may show no defect. It is difficult, however (according to Symonds), for anyone who has studied a large number of these cases to escape the conclusion that the organic factor is present.

Experience of the more severe effects of brain injury shows that the highest levels of cerebral function are the most vulnerable and the last to recover. Close observation of the symptoms which are described under the term "nervous instability" has convinced Symonds that they are in part due to a disturbance of function at these highest levels, as a physical effect of the trauma. As a result the sufferer is not himself. His best qualities are in abeyance, revealing the second-best. He is slightly less of a man, and more of a child. Hence there is a tendency for his reactions to inner need or external stress to be inadequate or neurotic. The greater the stress, as in the case of a workman with dependants, and without reserves of capital, the greater the liability to neurosis.

E. Guttmann (1943*a*) has also found the importance of psychological and social factors in the causation of late symptoms. Observation in young soldiers with no apparent predisposition brings out one point not mentioned by Symonds, i.e. the precipitation of a neurosis by an injury in a person who had been under psychological stress before.

In Schaller's view (1939), the post-traumatic *concussion state* produces reversible changes of brain function which, in severe cases, may become irreversible, with demonstrable pathological change. The post-traumatic *psychoneurotic state* is characterized by fear, suggestion and wishful thinking; it is due to the precipitation of psychic complexes, following a period of meditation, in patients presenting inadequate personality traits and subjected to adverse mental influences. In comparing 100 cases of each group, he finds (among other differences) headache in 77 of the encephalopathics, as against 97 in the neurotics. Of the former, 30 per cent. went back to work in spite of symptoms, of the latter only 6. He gives the differential diagnosis of the major symptoms in the following table (slightly modified):

Encephalopathy.	*Neurosis.*
1. Wishes to work.	1. Does not wish to work.
2. Euphoric, aggressive, periods of explosive irritability.	2. Depressed, emotional, complaining.
3. Amnesia of injury; memory and concentration difficult.	3. Mentally alert.
4. Changes from original personality make-up.	4. Aggravation of inherent personality defects.
5. Often severe injury, followed by unconsciousness.	5. Frequently slight injury.
6. No hysterical symptoms and signs.	6. Hysterical symptoms and signs.

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Encephalopathy.	*Neurosis.*
7. No exaggeration in statement and behaviour.	7. Exaggeration.
8. Tendency to improvement.	8. Tendency to aggravation.
9. No favourable effect of compensation settlement.	9. Favourable effect of compensation settlement.
10. Constant and precise symptomatology.	10. Multiplicity, changeability and indefiniteness of symptom.
11. Headache frequently absent.	11. Headache rarely absent.
12. Dizziness, vertigo.	12. Dizziness, giddiness.
13. Intolerance to heat and alcohol.	13. No such intolerance.

Lewis and Jones (1941) have shown how frequent headache and dizziness are in effort syndrome, and Lewis (1942) found mild headache, dizziness and fatigue equally often in neuroses of mixed type as in post-concussional neuroses. Only severe headache was more frequent in the latter.

According to Symonds (in Brock, 1940), total disability due to permanent mental incapacity of the organic type is a rare consequence of generalized brain injury. But though total disability is rare, residual symptoms of mental disorder belonging to the organic reaction type are by no means uncommon. In cases of moderate or severe injury these symptoms may be very slow to recover, so that it may be a year or more after the accident before the patient has regained his normal mental state. In some cases recovery is never complete. In the intellectual sphere there may be slight but permanent impairment of memory, especially for recent events, impaired judgment, and insight may be imperfect. The patient may consider himself normal, though it is apparent to his intimates that he has never been the same man since his accident. An increased liability to fatigue over mental tasks is an almost constant feature of the syndrome, as also an increased susceptibility to the effects of alcohol. The tolerance for alcohol is one of the most delicate tests of the degree of recovery.

These defects of mental function are of relatively small consequence in a manual labourer, but they may so reduce the capacity of the intellectual worker that he is permanently unfit to return to his business or profession.

There is no constant relationship between the degree of residual mental defect and the severity of the generalized brain injury as measured by the duration, either of the period of unconsciousness, or the post-traumatic amnesia. There is a general correspondence, but with striking exceptions. Apart from irritability, changes of mood and general disposition are rare in adults, though previous personality traits may be exaggerated. In children, on the other hand, changes of behaviour may be a striking symptom of cerebral injury (Blau, Tramer, Northfield). This aspect is dealt with in the chapter on Child Psychology.

The diagnosis of intellectual deterioration following head injury is only one aspect of the diagnosis or of the measurement of dementia in general. M. B. Brody (1942) has recently published several important contributions to this problem, and he has worked out an abbreviated technique for measuring deterioration by means of a " discrepancy score," which follows the lines of the Babcock Test. He uses the 1916 Stanford Binet Vocabulary Test applied

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with his own short technique (Brody, 1941). Secondly he uses tests of opposites, general information, substitution, sentence repetition, and uses the discrepancy between the second set of tests and the vocabulary score as a measure of deterioration. His test is simple and short in application and scoring, and it requires no elaborate apparatus. It has not been tried out yet in cases of head injury, but it seems promising for this purpose. The same is true of the Shipley Hartford Scale for measuring intellectual impairment. Another technique worth considering is the application of the Wechsler Intelligence Test. The author himself is very reserved in his expectations as regards this use of his test. He considers the task of measuring mental deterioration quantitatively as far from easy:

"While we cannot as yet use mental tests for obtaining the person's deterioration quotient or even express his loss of ability in terms of such and such per cent., we can use tests to determine relative degrees of deterioration in a rough way. Various studies have proved that individuals with mental impairment do much better on certain tests than they do on others, and it is possible to compare various disease entities with regard to degrees of impairment in individuals suffering from them." The author finds that the following tests out of his battery hold up with age: Information, comprehension, assembly, picture completion (vocabulary). Tests which do not hold up with age are: Digits forward and backward, arithmetical reasoning, digit symbol test, block design and similarities. His table of comparison between various clinical groups shows that both organic brain diseases and psycho-neuroses score higher on verbal than on performance tests. His table 31 (page 149) also shows little difference between neurosis and organic brain disease. In other words, one cannot expect much help in the differential diagnosis of the later stages of head injury from Wechsler's battery of tests.

Nadel (1938) examined a comparatively small number of cases with organic disease of the left or of both frontal lobes, and compared them with a similar number of cases of organic disease located elsewhere in the nervous system. He used a battery of tests, including Koh's Block Designs, a colour-sorting test, Rorschach and others, and analysed the results with regard to the quality of the behaviour rather than numerically. The frontal cases lost the abilities which the author calls abstract behaviour, i.e. the ability to devise a course of action and to vary the approach to a given problem. But when the procedure was altered so as to require no choice of behaviour, they would succeed with the problem. Such a behaviour is called "restricted" or "concrete."

Steinberg (1941) studied in detail 37 cases of head injury in a mental hospital. He found deterioration—as determined by the Babcock method—with the same frequency in cases with and without fracture of the skull. Factors of prognostic significance with regard to deterioration were found to be the patient's age at the time of injury, the occurrence of convulsions and of paranoid reactions. Most of his cases showed a progressive deterioration, in particular those with a prolonged psychotic syndrome following head injury.

Brussel (1942) studied the difference in response of the neurotic and the organic post-concussion case to the Rorschach test. He described the following signs as characteristic of the neurotic:

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1. The number of responses is not more than 25.
2. The number of human movement responses is not more than 1.
3. Animal movement responses outnumber the human movement responses.
4. Colour shock occurs.
5. Shading shock occurs.
6. Refusal or rejection of more than one card.
7. More than 50 per cent. pure formal response.
8. The percentage of animal response is greater than 50.
9. More than one formal colour response.

These neurotic signs are contrasted to those described by Piotrkowski as characteristic of the organic case. In addition to the usual method he uses a graphic method which has not been described yet in detail. The significant performance of the organic patient in this modification of the test is:

1. Attempt to include details irrelevant to the concept, losing relation to the whole.
2. Totally indiscriminate use of the blot to include every detail.
3. Intense effort toward precise reproduction.
4. Automatic colour matching.
5. Absence of addition pertinent to the concept.

The performance of the neurotic is characterized by the omission of details without disturbance of the integrity of the whole, and by the inability to make supplementary additions.

Using both these methods the author reached nearly 100 per cent. agreement with the clinical diagnosis.

Halstead (1939, 1940) studied cases of local (operative) cerebral injury by means of an elaborate sorting test.

A tray with 62 articles of everyday use was shown to the patients and the range of the patients' interest and familiarity with the objects assessed. The patient was then asked to place together those objects which seemed to him to belong together. His immediate recall of the objects used was tested next, and finally his capacity for abstracting was assessed by asking him why he placed the objects together in the manner he did, and whether he could think of another way of grouping them. There were also some objects added to or taken away from his groups in order to find out whether he was able to reach the level of abstraction.

Normal persons and patients with lesions outside the frontal lobes recalled a greater number of the test objects which had been grouped than of those which had not been grouped. This effect of grouping was absent in frontal lesions. Frontal cases also showed paucity of categories, the tendency to produce groups of one object, and a marked resistance in shifting to alternate ways of grouping. The disturbance of abstraction thus indicated was present even in cases in which the post-operative social adjustment was good, and in which the formal intelligence of the patient was unaltered.

Examination of disability following a head injury should be based on the end-results of the injury, and not on the initial symptoms and signs (Kessler, 1941). The latter are to be utilized only when final examination fails to disclose evidence of pathology. In the absence of mental changes, severe head

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trauma may be finally assessed 6–12 months after the initial injury. The important point to emphasize is that at the same time the symptoms of headache and dizziness are being checked, and the severity of the resulting disability in the human economy is being determined by reliable accurate tests of increased intracranial pressure. If vestibular disturbance prevents a man from walking, but allows him to sit without difficulty, regardless of the spinal fluid findings, an estimate of 50 per cent. should be made. If there is involvement of the optic disc, the disability thus caused is added to the 50 per cent., but the total is not to exceed 100 per cent.

Another method of estimating permanent disability is one in which subjective symptoms and objective signs are grouped according to their severity:

1. Cases with non-localizing symptoms.
2. Cases with localizing symptoms.
3. Cases with epileptic manifestations.
4. Latent cases.
5. Cases with late aggravation.

For the first group a rating between 5 and 20 per cent. is suggested. In the serious cases of the remaining groups, 20–50 per cent. are recommended, whilst those of an extreme character are rated at 100 per cent.

In the case of traumatic neurosis, it becomes incumbent upon the physician to evaluate the man's permanent incapacity to work. A man who is lame in both legs may be perfectly able to work, while a neurotic may be completely incapacitated. Any system of evaluation is therefore necessarily arbitrary. Kessler's own method is to allow a compensation for a period of one year; during that interval the patient is observed in a curative workshop, and given psychotherapy. Final awards vary from 33–100 per cent.

"Punch drunk" or traumatic encephalopathy is the result of repeated injury to the skull, as most commonly seen in professional pugilists. Apart from the neurological signs (slurred speech, disturbance of equilibrium, extrapyramidal disturbances) it is characterized by intellectual impairment, which has to be diagnosed from pre-existing mental defect. Will (1939) and Jokl (1941) have published case-histories and discussed problems of prevention.

Precipitated Psychoses.

Psychoses not "organic" in type following head injury are of considerable interest to psychiatrists; in particular, schizophrenic reactions after physical trauma touch on the fundamental problem of aetiology in psychiatry. Generally it can be said that research and publications are still at the stage of assessing the frequency and sorting out the available material.

According to A. J. Lewis (1942), post-traumatic psychoses have an incidence of 19 per hundred thousand of the male population. The rate rises from 10 in the 20–29 age-group, to 16 in the 30–39 group, 20 in the 40–49 group, and 25 in the 50–59, 60–69 groups. This increased incidence as age advances cannot be accounted for by an increase in accidents sustained, but must be construed as another instance of how the ageing process is itself, with its reduction of functions and loss of resilience, a very prominent cause of these traumatic

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psychoses. In short it is more an involutional or presenile disorder here than a traumatic one, and the age distribution is very similar to that of presenile and other degenerative organic psychoses.

Malzberg (1937) reported that in New York State the percentage of first admissions of persons with traumatic psychoses rose from 2·1 per million of total population in 1910 to 9·5 in 1935.

Tennent (1937) studied 44 cases of psychoses following head injury admitted to the Maudsley Hospital from 1923 to 1936. All showed the typical organic syndrome in the beginning. In five cases, when the confusion decreased, hallucinatory experiences and bizarre or paranoid delusions became prominent—in other words they developed schizophrenic psychoses. Four out of these were reserved, seclusive and definitely schizoid before their injury. Two had had hallucinatory experiences before. None of the cases improved. In five others the organic reaction developed into a depressive illness. In three of them there was a history of treatment for a similar depressive illness some years previously. Two others developed a manic reaction—proof of a manic-depressive psychosis. Of the rest of the cases four recovered, two became permanent inmates of mental hospitals, and one died.

Three cases occurred in children under 16 years of age; one was a depressive who had had a manic phase before. Two showed behaviour disorder and demoralization, one permanent, so that he had to be admitted to an institution as a moral defective. The other improved, but remained a problem.

The remainder were acute traumatic psychoses which recovered, but a third of the patients showed residual symptoms which interfered with their health and their ability to earn their living.

Vyner and Swirn (1941) found 67 cases of post-traumatic psychoses in a resident population of 8,796 patients at a mental hospital, i.e. 0·76 per cent. An inference as to the rarity of this group is obviously not permissible, since the duration of treatment of traumatic cases as compared with, say, chronic schizophrenics was not taken into account. The cases were divided into traumatic delirium (15 cases), post-traumatic personality disorder (27 cases) and post-traumatic mental deterioration (25 cases). Twenty-six of the cases showed focal neurological signs; 18 had epileptic fits. There were 30 alcoholics among the group, and 20 patients showed signs of cerebral arteriosclerosis at the time of the injury. The pre-morbid personality was described as schizoid—seclusive, unfriendly and shy—in 18 patients, and as psychopathic in another 4. Fracture of the skull had no relation to the type of severity of the mental disturbance that followed, but patients with fracture were more prone than others to develop convulsions. Ten cases had air encephalograms done, but in 4 the ventricles were not filled (? by the lumbar route: no attempt at verification by cisternal injection or ventriculograms seems to have been made). Six cases showed moderate generalized cerebral atrophy; there was little difference in the extent of atrophy in the comparatively recent cases and those of long duration. From this it would seem (to the authors) that the cerebral atrophy is not progressive, but reaches its highest within one or two years following the injury. However, the number of cases seems too small to allow such a generalization. The same is true of the authors' statement that the

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presence or the duration of unconsciousness following head injury is not related to the severity of the mental reaction.

Hoch and Davidoff (1939) studied 250 cases of post-traumatic psychoses, about half of which were complicated by alcoholism, cerebral arteriosclerosis, senility, neurosyphilis, mental deficiency, etc. The prognosis was found worse in these complicated cases, whereas fracture of the skull was of no prognostic value. The most interesting findings of the author refer to the effect of the pre-psychotic personality type on the outcome, as given in the following table :

	Introvert.	Extrovert.
Recovered	3	24
Much improved . . .	3	50
Improved	11	41
Unimproved . . .	47 (73%)	72 (38%)

With regard to the more specific problem of schizophrenia, Brill quoted Kraepelin as saying that in a very large number of cases schizophrenia is entirely independent of external conditions of life ; it is the outgrowth of a constitution and cannot be produced by external causes. The first World War has amply demonstrated that the most severe hardships, the most exhaustive psychic traumas as well as the cerebral injuries have not produced any increase in the number of schizophrenics. In reply to a question about the possible precipitation of schizophrenia by trauma, Dr. Brill stated that " a patient who reacts schizophrenically is constitutionally a schizophrenic." Those who have such a constitution can get schizophrenic episodes for one reason or another—it may be due to age, stress, or accident. If a person was well past the age of 40, i.e. past the dangerous period of schizophrenia, one might say that the accident acted as a precipitating cause. But the author would still maintain that neither the insurance company nor the Government are responsible for supporting the patient for the rest of his existence.

Bostroem (1940) stated very authoritatively that psychoses of endogenous type after head injury develop only if there exists an endogenous predisposition.

Comparing the incidence of schizophrenia in the average population with that in a group of 1,554 head injuries Feuchtwanger and Mayer-Gross (1938) arrived at the conclusion that the incidence of schizophrenic " processes " among the latter was only slightly (0·55 per cent.) higher. Including, however, schizophrenic reactions and defects, the figure was more than three times as high as in the average population. Twenty-three case-histories are given in detail. In five cases paranoid psychoses were closely connected with manifestations of traumatic epilepsy ; in four other cases traumatic epilepsy also existed, but the onset of the schizophrenic psychosis followed an improvement of the epileptic symptoms. In the largest group a schizophrenic process was observed without any epileptic signs.

Shapiro (1941) found that in 21 out of 2,000 cases of schizophrenia a close relation between trauma and the onset of psychic symptoms was shown. In ten cases there was no injury to the brain, but the mental symptoms developed in a close time relation to a severe head injury. All the patients in this group had a positive family history, and were introverted personalities. Thus in these

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cases the trauma may have precipitated latent tendencies. The trauma acts simply as a precipitating factor. The remaining eleven cases showed evidence of cerebral damage (confusion, dizziness, defect in memory and orientation, persistent headache with irritability). In seven cases in this group the pre-psychotic personality was well integrated, and only in two cases was a positive family history present. In these cases the trauma did more than precipitate a psychotic reaction. In producing pathological changes in the brain, the injury would seem to have contributed to the formation of the clinical picture.

Morsier (1939) published three cases of schizophrenic psychosis following head injuries of greater or lesser severity. He expressed his opinion that, in the present state of our knowledge, the causal connection must be admitted, if there was no heredity, and if transitional symptoms existed between the accident and the manifestation of schizophrenic symptoms. As symptoms of transition (*Brückensymptome*) he would accept not only epileptic fits but also signs of traumatic encephalopathy, such as headache, vertigo, disturbed memory.

Keller and Miller (1940) reported the interesting case of a woman admitted in a manic state. She had been unhappily married to an alcohloic. When she intended to leave her husband he struck her, knocked her down and beat her head against the ground. She escaped, and she does not seem to have been unconscious at all. A fortnight later she developed severe headache, and about four weeks after the incident her behaviour changed ; she began to talk loudly, became demanding, irritable and careless of her appearance, and went out with strangers at night. Admitted in a state of manic excitement with restlessness, flight of ideas, etc., nothing was found on examination to point to organic cerebral damage. But on the eleventh day of treatment she developed a Jacksonian attack, followed by a series of further convulsions within the next 24 hours, ending fatally. The post-mortem showed three linear fractures of the skull, extensive thrombosis of meningeal veins, a large area of necrosis in the right cerebral hemisphere, swelling of the brain, and widespread petechiae.

Jequier and Bovet (1939) reviewed the problem of the precipitation of G.P.I. by cranial trauma. They are inclined to recognize the traumatic character of the disease if (1) the patient was free from symptoms at the time of the accident, (2) the accident was concussion or fracture of the skull (not an emotional shock), (3) symptoms existed continuously between the accident and the diagnosis of G.P.I., (4) the development was rapid, and (5) the incubation period short (often indicated by the patient's low age).

E. Guttmann (1943*c*) studied the effect of suicidal head injuries on depressed patients. He saw two patients with endogenous and one with reactive depression recover mentally as a result of a severe injury to the frontal lobes in two, to the left temporal lobe in one case. One case of psychopathic depression with a laceration of the posterior part of the left temporal lobe showed no change. One recurrent endogenous depressive was not changed by a mild concussion. He compared his own cases with two cases of injury to the basal part of the frontal lobes, also suicidal, resulting in a marked change of personality, and he reached the conclusion that in his case the recovery was not due to the localization of the injury but to the cerebral damage in general, and to psychological factors, such as the fact of being ill, change of environemnt, etc.

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Baonville and collaborators (1939) published a case of an excitable psychopath who, in a suicidal attempt, shot himself through both frontal lobes. Apathy, loss of initiative and disturbance of attention were the main features in the clinical picture after surgical recovery; egocentricity, suggestibility and puerile euphoria are also mentioned. There was some disturbance of memory and concentration. The patient died subsequently in an epileptic fit, and the post-mortem showed destruction of areas 8, 9 and 76.

Post-traumatic Epilepsy.

P. B. Ascroft (1941) investigated the fate of men who sustained gunshot wounds of the head in the last war, with special reference to the development of epilepsy. He examined 540 case-histories of patients who had survived long enough to be re-examined four years after they were first boarded for head injury by the Ministry of Pensions. Only 317 cases were satisfactorily complete. Out of these, 107, or 34 per cent., had fits. Fits were twice as frequent when the dura was penetrated. 45 per cent. of such cases were affected. When the wounds were septic, the incidence of epilepsy was much higher. In about a quarter of the cases epilepsy starts in the first month after the injury, in half of the cases within the first six months. In a third of the cases in which the course of the illness was known, the fits had ceased some years before the patient was last examined.

H. G. Garland (1942) studied a mixed group of epileptics. He found a history of head injury in 6 per cent.; the age distribution of incidence suggested that most of the cases seen were of the idiopathic type.

Feiling (1942) reviewed some literature on the incidence of traumatic epilepsy following blast injury, but did not arrive at any definite conclusions as to what factor or factors really determine the origin of epilepsy.

Harrower-Erickson (1940) studied the Rorschach responses of patients with focal epilepsy who had been treated by local brain excision. Though in most of her cases no connection with a previous head injury was established, her findings may be applicable to cases of post-traumatic epilepsy. Her most important finding was the rarity of the occurrence of the "restricted" picture, found in other organic lesions. Though most of her patients showed some deviation from the norm, they did not exhibit such characteristics that the term "epileptic personality" could be attributed to them.

Elridge (in Brock, 1940) in 362 head injuries (peacetime hospital admissions) found 17, or just under 2 per cent., cases which developed seizures shortly after the injury. In 43 cases of late epilepsy (from another source) the onset of the fits was on the average over five years after the original injury.

Troeger (1938), comparing the families of traumatic epileptics with those of cases of idiopathic epilepsy, found no evidence for the assumption that heredity plays a part in the origin of post-traumatic epilepsy. In some of his cases endogenous factors might have been of some importance, but this is impression rather than scientific evidence.

Wilson Gill (1941) published three cases of narcolepsy in which he assumed a trauma to the skull to be the responsible factor. Some cases of narcolepsy are known to be due to a localized mild encephalitis; trauma to the skull may b

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expected to cause similar effects, if damage is localized in the region of the hypothalamus and the third ventricle.

Prognosis.

Symonds and Ritchie Russell (1943) studied the prognosis of head injury in Service cases. Out of 242 consecutive cases 91 per cent. returned to duty, 9 per cent. were invalided. A follow-up showed that a further 11 per cent. were invalided later. Out of 718 cases which were not admitted immediately after the injury but at various intervals afterwards, the prognosis was much worse; this was not unexpected since the cases were largely selected for admission because their progress had been unsatisfactory elsewhere. Their relatively bad prognosis did not depend on more severe injury, as judged by the duration of post-traumatic amnesia. There was a positive correlation between the bad prognosis and a higher incidence of predisposition to mental disorder. In selected cases of flying personnel the prognosis for return to duty was four times as good as in all the other cases of the series. It may be assumed that the main reason for the better prognosis was that the air crews were a highly selected group in respect of absence of predisposition to mental disorder.

E. Guttmann (1943*a*) studied the prognosis in civilian head injuries. Three hundred consecutive admissions to an accident service in a mixed urban and rural district were the material of his investigations. Four per cent. of the cases died in hospital; two became invalids through cerebral damage. Eighty per cent. of the cases were treated in hospital for fourteen days or less. The average working time lost by wage earners was roughly eight weeks. In mild cases (i.e. those with a post-traumatic amnesia of one hour or less) the average loss of working time was four to five weeks, in severe cases (post-traumatic amnesia one to seven days) about nine weeks, and in the severest cases fourteen weeks. In patients who stayed off work for an unusually long time, excluding the cases of cerebral damage, it could be shown that social and psychological factors rather than the physical effects of the accident were responsible. The same author had shown in an earlier investigation that only roughly 20 per cent. of the cases had any subjective symptoms three months after the accident or later.

Ritchie Russell (1942) followed up a consecutive series of 200 admissions of head injury, and he found that 87 per cent. of them returned to full work within six months of the injury. His figures showed very clearly that the duration of the disability bore little relation to the presence of a fracture. Counting all symptoms, including slight ones such as an occasional headache, he found the duration of symptoms under 2 months in 40 per cent., 2 to 6 months in 5 per cent., 6 to 18 months in 15 per cent., and over 18 months in 40 per cent. of the cases.

The largest clinical and statistical analysis on the prognosis of cranio-cerebral injury was published by Cedermark (1942). He was able to follow up over 1,700 cases. 146 of these died after their discharge from hospital, whereas the expectation compared with the average population in Sweden would have been 102 only, yet in only a few cases had the subsequent death any connection with the injury. The author is inclined to think that the increased

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mortality was due to arteriosclerotic changes. The death-rate became normal about eight to ten years after the injury. In 7 per cent. of the cases the earning capacity was reduced by 10 per cent. or more. The figures for insured and un-insured patients did not differ. There was a positive correlation of 0·84 between the occurrence of objective symptoms and of symptoms of neurasthenic and psychogenic kind. Late symptoms were found in about a third of those followed up, in about half of the fracture cases and in a quarter of the cases without fracture. These figures did not vary at three, five and ten years after the injury for adults; among younger patients the figure tended to fall over a longer period of observation.

In only four cases was there reason to suspect a serious change of personality; in no case was a chronic psychosis found. Five patients had episodic psychoses and severe psychogenic reactions during the later course of recovery. In three of these cases, however, the connection with head injury was questionable.

Epileptic fits were found in 1 to 2 per cent. of the cases observed over ten years. In a number of cases, however, the traumatic character of the epilepsy was doubtful.

The writer's material did not allow of any definite conclusion as regards the effect of long bed treatment on the final outcome, but his figures for the duration of in-patient treatment needed are of interest. The median for in-patient treatment was 7·6 days, with the lower and upper quartiles at 3·7 and 16·5 days respectively. The median for fracture cases was 14·2 days. The working time lost for the total material was up to 1·7 weeks for one quarter of the cases, 3·7 weeks for half of them and 2·4 months for three-quarters. The author gives also figures for the time his patients spent in bed, in hospital and at home together. This combined period was up to one week for a quarter of the cases, two weeks for half of them, and one month for three-quarters. Finally, he determined the time when the patients considered themselves recovered, i.e. the point when the after-effects disappeared. For the whole material the lower quartile was 1·4 weeks, the median 3·5 weeks, and the upper quartile 2·5 months.

Treatment.

Surgical treatment in the strict sense of the word is not the subject of this review. As regards the problem of dehydration, it can fairly be said that most neurosurgeons in this country employ it only in selected cases, i.e. in those in which manometric tests have shown an increased intracranial pressure. Lambert Rogers has recently put the case for dehydration, but, as Ritchie Russell has pointed out, his evidence is not convincing, since it refers only to selected cases.

Cairns (1942*b*) has emphasized that there is no need to keep a patient in bed for any rigidly determined length of time after he has recovered consciousness. An investigation by With lends support to his view. This author reviewed 394 cases treated with individualized confinement to bed according to their symptoms. The time of bed treatment was:

Under 1 week . .	in 65%
1 to 2 weeks . .	,, 24%
2 to 3 ,, . .	,, 8%
3 to 4 ,, . .	,, 2%
Over 4 weeks . .	,, 1%

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The results of a follow-up study 5–15 years afterwards were most encouraging. Work was resumed within one month of discharge in 66 per cent. and within one to three months in 18 per cent. Less than 1 per cent. were permanently disabled.

The rehabilitation—i.e. the non-surgical treatment of head injuries—was discussed at a meeting of the Royal Society of Medicine (1942). Jefferson, opening the discussion, formulated his view: "We must beware of the danger of coming to regard all who have had a head injury as neurotic, though it would be not far wrong to regard all of them, as I remember that we do, as potential neurotics."

According to Jefferson, two stages should be considered in rehabilitation. The first covers the period during which the patient is in hospital, confined to bed or ambulant. He warns against over-emphasizing the value of physiotherapy. Rehabilitation in a diversional form should be instituted early, whilst the patient is confined to bed. It will take the form of reading, or being read to, jigsaw, crossword or other puzzles, drawing, needlework, basket-making, sewing, knitting and rug-making. The patient convalescing from head injury should be encouraged to use his mind, and take an active part in his treatment. This first stage will last about six weeks. The second stage is that of hardening. Military cases, at this stage, should be taken over by their respective service. Civilian cases should have gymnastics and physical training, and work in the garden, or in the carpenters' and engineers' shops; walks, organized games and visits to the town, for the purpose of finding out how the patient reacts, will play a part. It is an essential of rehabilitation that it should be planned by a time-table each day. H. Cairns (1942*b*) pointed out the importance of the time factor for deciding when a patient should be considered fit for return to work or duty. He drew up a tentative time-table grading the severity of the injury according to the post-traumatic amnesia. As a working rule he suggested that the shortest time in which ability to carry out full work may be expected to return is as follows:

Post-traumatic amnesia	5 minutes–1 hour . .	4–6 weeks.
,,	,, 1–24 hours . . .	6–8 ,,
,,	,, 1–7 days . . .	2–4 months.
,,	,, over 7 days . . .	4–8 ,,

Rehabilitation, according to him, begins when the patient commences to talk, and to respond properly. He rarely finds a reason why the patient should not be allowed to get up a few days after he has recovered consciousness. If he gets a headache he can be put to bed, given some aspirin, and he can get up again the next day. It is, however, rarely necessary, for headache is not a conspicuous feature of this stage of recovery. From the day of getting up, graduated physical and mental exercises may begin. The importance of psychological factors is stressed, and no attempts at rehabilitation are considered likely to be successful unless the patient's anxieties and fears are assuaged, and unless he is helped through the phases of depression and other disturbances of feeling that so often beset him during recovery from head injury.

Russell Brain (1942) found that the incidence of neurosis is much higher after

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head injuries due to industrial accidents than to those following road accidents, and he showed that in industrial accidents the high incidence of neurosis is associated with the less severe injuries. In both groups the incidence of neurosis is highest in the unskilled labourers. Men of any occupation are specifically more likely to develop traumatic neurosis if they are injured in an industrial accident, even though their organic injury is likely to be less serious. The remedies he suggests are: (1) The rehabilitation in all cases of slight injury is primarily in the hands of the general practitioner or casualty officer who first sees the patient. These "front line workers" need to learn the right psychological handling of the injured man, and to avoid suggesting serious injury when none exists. They should also learn to avoid the hospitalization of really slight cases. (2) All big centres need a unit of doctors trained to deal with head injuries, both slight and severe. (3) Occupational therapy should merge into therapeutic occupation, i.e. organized light work. (4) The social responsibility for the injury should be more widely recognized, and the emphasis changed from compensation to rehabilitation. He finally suggested alterations in the Workmen's Compensation Act to that effect.

In another paper on rehabilitation after head injury, Cairns (1942*c*) described some causes of failure. Return to work too early is one of the common ones. A physical softness on return to the outside world is another cause of breakdown, particularly in the Services. The more serious causes of failure include loss of intellectual capacity, epilepsy, and disabilities resulting from gross brain damage. In this group of cases the patient will not be able to return to his previous occupation, but, with adequate facilities for vocational training, much can be done to make these patients into useful members of society, and, at the same time, to regain for them their self-respect.

A. J. Lewis (1942) considers the treatment to be more preventive than actual. He regards the essentials of preventive treatment as (1) To decide early what plan to adopt, and, as far as possible, to adhere to it. (2) To let the patient know, as soon as may be, that he will, or will not, have such and such residual disability, and that he need fear only so much incapacity, or none at all eventually. (3) To see that misguided relatives or friends do not tell him a highly coloured story of the accident, but that it is explained to him soberly and with due allowance for his amnesia and other symptoms. (4) Not to prolong the period of rest and inactivity, but to institute early some mild work or interests, not more exacting than his state warrants, and gradually to increase both the opportunity for activities and the incentive, taking care on the other hand to avoid overtaxing him to the point where frustration and "catastrophe reaction" could lead to an exaggerated concern over his disability. (5) To help him in any financial, legal or domestic embarrassments to which the accident has conduced; a skilled social worker is here most valuable. (6) To do everything possible to bring the phase of special examinations to an end, except in so far as they are necessary for assessing progress or deciding on special methods of treatment or disposal.

Munro (1938) considers only 30 per cent. of his cases as operative. In the non-operative cases he divides convalescence into three stages. The first begins when the intracranial pressure has been re-established to normal level. During

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this period the damaged tissues should heal, and this can be accomplished by keeping the patient flat on his back in bed for two weeks from the time when his intracranial pressure has been demonstrated to be back at normal.

The second period begins at the end of the second week of convalescence. It is divided into two parts, the first in the hospital, and the second at home. The length of time involved depends on the activity, the intelligence and co-operation of the patient. Five to six weeks are usually required. During this period the patient should get out of bed and gradually increase his activity. He should also demonstrate to himself and to his family that he can move about without symptoms. Before leaving the hospital, the patient and his friends and relatives are seen, and are told that his injury is healed, what kind of injury it was, and what the permanent after-effects are likely to be. The patient is reassured against his common fears, and is given a schedule of how to live for the next four weeks.

The third period extends from the end of the first month after discharge to the time when the patient returns to work. The psychological management is directed to the purpose of getting the patient himself to wish to go back to his own activities.

In a recently published book on the after-effects of brain injury Goldstein (1942) includes a long chapter on the treatment of aphasia and kindred disorder. It contains a detailed description of the approach to the re-education of patients with focal disturbances which will be most valuable to all who have to deal with such cases. The author stresses the general principles and the individual approach. A thorough psychological analysis of the preserved faculties and of the patient's ability to use them form the basis for the training which should enable the patient to regain his functions, though using new techniques. The author also describes his methods for improving the working and earning capacity of the patient with cerebral injury, vocational guidance and other ways of social readjustment.

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NEUROSYPHILIS AND ITS TREATMENT.

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An extensive review of recent advances in the aetiology and treatment of neurosyphilis was published in this journal by one of us, E. L. Hutton (1941). While it is mainly the later manifestations with their crippling disabilities that present themselves to the psychiatrist in the mental hospital, it is becoming increasingly obvious that early treatment is imperative to obtain good results, and that neurosyphilis itself must be regarded as a preventable disease.

Asymptomatic Neurosyphilis.

Laboratory tests, the state of the blood and cerebrospinal fluid, afford us knowledge more complete than for any other diagnostic category in psychiatry. O'Leary (1939) defines asymptomatic neurosyphilis as "that manifestation of syphilis which is characterized by a positive spinal fluid test, and in which there are neither signs nor symptoms of invasion or involvement of the central nervous system." His figures give 35 per cent. of early syphilitics as having a positive fluid; some of these have spontaneous cures, others respond to usual forms of adequate treatment; even so the fluid remains positive in some 15 per cent. of cases four years after the primary attack. This smaller group he regards as a potential forerunner of clinical neurosyphilis. In some cases a definite paretic formula is revealed by examination, but in any case if the fluid remains positive after six months of ordinary routine treatment (a trivalent arsenical combined with a heavy metal), it must be assumed that the patient has a resistant type of infection (probably of a paretic type), and a change to a pentavalent arsenical or fever therapy is indicated. Adequate therapy and negative results of blood and fluid at the end of a year should guarantee the patient against any subsequent involvement of the central nervous system. A case, however, is recorded by Kopp and Solomon (1941) of a patient who developed general paralysis following essentially normal spinal fluid findings, and in spite of fairly continuous antispecific therapy over a period of 14 years. This patient was examined 14 and 22 months after treatment, with negative fluid results, but there was the significant point that in the first examination the cell content was slightly increased to 22 cells.

O'Leary reports that patients with a mildly positive fluid showed the lowest incidence of clinical progression, while those with a paretic fluid gave evidence

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of clinical progression four times as frequently. Again, those who received less than ten injections showed an incidence of clinical involvement three times as great as those who received 20 or more injections of arsenic plus a heavy metal.

Paul B. Jossmann (1940), in an analysis of 386 G.P.I.'s and 798 tabetics admitted between 1910 and 1924 to the Charité Hospital, Berlin, found that inadequate treatment influences the development of neurosyphilis by shortening the incubation period. He also records that cases having no treatment at all have the longest incubation, from which he draws the conclusion that inadequate treatment interferes with the resistance built up by the patient, thereby hindering antibody formation.

Diagnosis.

Too much stress cannot be laid on the necessity for doing lumbar punctures, not only in order to establish or confirm a diagnosis, but also to assess the progress of treatment, and in some cases the choice of any particular method. Augustus S. Rose (1942) classifies the changes of the asymptomatic case according to the degree of abnormality of the fluid—Group I a minimum involvement with cells ranging from 5 to 20 per c.mm., protein 30 to 50 mgm. per cent., a negative gold curve and a Wassermann either negative or weakly positive; in Group II fluid cells vary from 20 to 60, protein 40 to 70 mgm., the gold curve slightly altered, 2344321000, the Wassermann being weakly or strongly positive. Group III fluid with increased cells up to 100, protein 60 to 150 mgm., a paretic gold curve, 5555543200, and a strongly positive Wassermann is the most resistant to treatment. Patients with the Group III or paretic formula are liable to develop general paresis. Patients with Group I fluid react well to ordinary treatment, the changes are frequently seen in late cases of vascular neurosyphilis, while those with Group II respond less satisfactorily to routine methods and require tryparsamide or even fever therapy. The third group demand more energetic treatment, such as tryparsamide, malaria or other artificial fever agent.

Dattner and Thomas (1942) consider that: (1) In untreated syphilis a positive Wassermann of the cerebrospinal fluid with negative findings in other tests does not prove activity, whereas if it is associated with increased cells and protein, activity must be assumed. (2) In cases receiving specific therapy, normal cell count and protein content merely indicate that the infectious process is inhibited; it may become active again six months after treatment is terminated. (3) If, six months after treatment has been discontinued, the cerebrospinal fluid shows no more than three to four cells and definite diminution in protein, in all probability the activity of the syphilitic process in the central nervous system has been permanently checked. These authors maintain that in many cases the differentiation between meningovascular and parenchymatous involvement is extremely difficult, and even when a meningovascular lesion is clear, they claim that fever combined with chemotherapy is vastly superior to chemotherapy alone. The fever agent recommended is malaria.

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Aetiology of Neurosyphilis.

Fleming and Moore (1941) present three possibilities for variations in the course of the untreated syphilitic infection: (1) the infecting organism, (2) extraneous factors, such as intercurrent disease, nutritional deficiencies, pregnancy, and (3) the defence mechanism of the host. Much has been written on the possibility of a neurotropic strain of spirochaete as opposed to a dermatotropic strain. As far as extraneous factors are concerned, the evidence of any influence effected by associated tuberculosis is unconvincing, but pregnancy appears to exert a favourable influence on the syphilitic infection, while nutritional deficiency, especially in vitamins A, B, or both, may predispose to development of certain forms of neurosyphilis, especially tabes. Regarding the defence mechanism of the host, early tissue reaction is found more commonly in negroes, whereas in white races and in experimental animals the late manifestations, cardiovascular or parenchymatous neurosyphilis are more frequent. Some speculative theories are put forward with regard to the relation of infection to the habitus of the host—the sthenic or hyper- and hyposthenic individual. Patients with Group O blood become sero-negative more rapidly than those belonging to other groups. All these results are rather vague, and one is still at a loss to explain why one patient gets neurosyphilis and another does not.

The association of lesions of skin and mucous membranes in neurosyphilis is recorded in a paper by Clarence Shaw (1940). Among his own group at Chicago of 70 patients with late syphilitic skin, mucous membrane and bone lesions, 15 (21·4 per cent.) had a positive fluid, and 7 had asymptomatic neurosyphilis. Besides these he quotes figures from other workers; among 1,515 patients with tertiary lesions, the average percentage involvement of the central nervous system was 22·6. With control groups the incidence of a positive fluid was twice as great, thus indicating a possible difference in immunity in patients who have benign late syphilis.

Diagnosis of General Paralysis of the Insane.

An interesting account by Herman and Rosenblum (1940) gives some data on acute general paresis. These authors, while agreeing that G.P.I. is usually a chronic disease, present four types, fulminating, convulsive, catatonic, and acute confusional, with an acute onset and a rapidly fatal termination. The fulminating type is characterized by acute delirium with marked hallucinosis, physical signs are prominent, and the patient runs a febrile course, death supervening in one to three weeks. The convulsive and acute confusional varieties describe themselves, but the latter is more prone to subside, the patient assuming a chronic type with dementia. The catatonic type, with mutism and negativistic behaviour strongly suggestive of an acute schizophrenic process, gives rise to some difficulty in diagnosis, apart from the fluid findings, because according to Schilder and Parker (1931) fixed pupils are found under certain conditions in catatonic schizophrenic patients, especially negroes. For all cases treatment is urgent and imperative, and a course of tryparsamide has been recommended to improve the patient's general condition prior to malaria.

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Weinberg (1941) describes tumour syndromes in association with general paresis, one a meningioma in the spinal cord, and the other with a gumma in the cerebrum. Wexberg (1940) analyses 256 cases of cerebrospinal syphilitic affections: in addition to 38 cases of G.P.I. and 6 cases of cerebral syphilis with psychosis, there is left a group of 20 cases in which the differential diagnosis between G.P.I. and cerebral syphilis was not possible with present clinical methods. The author continues, "The insufficiency of our diagnostic methods is responsible for overlapping interstitial types, thus leaving the differentiation between interstitial and parenchymatous forms of cerebral syphilis in doubt in about 30 per cent. of patients with mental symptoms." In all these doubtful cases the cerebrospinal fluid examination remains the only test decisive in the determination of therapeutic application. A case of paralysis agitans with syphilis as a causative factor is described by Harris (1940), who quotes Jelliffe and White, "Neurosyphilis is so kaleidoscopic in its clinical manifestations, that the significance of the *Treponema pallidum* infection as a primary aetiological factor in the production of nervous disorders is frequently overlooked."

Treatment.

Malaria, artificial fever and chemotherapy have been employed singly and in combination, and their relative merits still afford much controversy. Before trying to assess the value of these different methods, we propose to review the literature of each method separately.

Malaria.

In two papers Bruce Mayne and Young (1941) and Gerstmann (1941) outline procedure and general indications for therapeutic malaria. Bruce Mayne enumerates the following contra-indications: (*a*) presence of any chronic infectious disease, (*b*) cardiovascular or renal disease, (*c*) severe emaciation, (*d*) galloping paresis, (*e*) severe anaemia, (*f*) liver dysfunction, (*g*) senility, (*h*) extreme obesity.

Quartan malaria is claimed by Fong (1940) as a useful agent for patients, especially negroes, who are immune to benign tertian, but even in negroes successful inoculations were obtained in only 53·2 per cent. of cases in a series of 436. He notes that the serologic results following induced quartan malaria corresponded in general to those obtained by benign tertian; the blood Wassermann, however, was much more resistant with quartan. Kroll (1940) gives an account of 62 patients, of whom 46 were coloured; he finds quartan of value for the case which requires a second course. Only seven inoculations were unsuccessful.

A study of febrile paroxysms resulting from induced infections of benign tertian is published by Coatney and Young (1942); 338 paroxysms in 21 patients were analyzed. The average duration of temperature of 100° F. and over was 10 hours 10 minutes per paroxysm with a height of 104·8° F. It was found that 201 paroxysms were accompanied by rigors, there being 137 without; the fever peak average was 0·7° F. higher in the rigor group; moreover the average rate of fever rise was 3·3 times faster during the rigor (1° F. in 17 minutes) than during any other period of fever rise (1° F. in 56 minutes).

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The almost constant feature of a quotidian type of fever in primary benign tertian malaria has always been a source of anxiety in the management of a case, and it has long been the practice in this country to give malaria in two stages by aborting the fever with a small dose of quinine (Nicol, 1942). A useful therapeutic procedure has been introduced from America by which 0·2 grm. of thiobismol is given to the patient after the fever has become established; this destroys one generation of parasites, and with unfailing regularity produces tertian fever, thereby giving the patient a rest every other day without fever. Papers relative to this action have been published in America by Schwartz (1939), Brunsting and Love (1940), Cole and others (1930), and in this country by Whelen and Shute (1943).

An analysis of deaths following therapeutic malaria is given by Wile and Mundt (1941 and 1942). These workers treated 1,026 patients between 1925 and 1940; the mortality-rate was low, only 29 deaths occurring during the paroxysms or immediately following their termination. The authors state, "The hazard may be reduced by a careful selection of cases, which presupposes a clear comprehension of the many indications and contra-indications, and by close observation of the patient during the course of the malaria . . ." They think that the mortality should have been lower, as included in the total are two suicides, which might have been prevented, and five cases with lung complications, who, with the advent of sulphonamides, might well have survived. Half the number died before the fifth paroxysm. The condition responsible for the largest number of deaths was circulatory failure or vascular collapse—symptoms identical with those seen in true medical shock. In five patients death was attributable to hyperpyrexia. Only in one case is rupture of the spleen recorded; this is a rare complication, though isolated cases have been recorded in the literature from time to time. Büttner and Hauer (1938) report a spontaneous rupture in a case inoculated with *Plasmodium ovale*.

It is interesting to note that 80 per cent. of the deaths recorded were in general paralytics (19 deaths out of 358 treated) and taboparetics (4 deaths out of 118 treated).

Hallucinatory psychosis and epilepsy are both unpleasant sequelae; a brief review of the literature regarding the former phenomenon is given by Tcherniak (1938), who reports 22 female cases, the prognosis being considered unfavourable. Roger and Alliez (1938) discuss the theories of pathogenesis of epilepsy; they adopt the view that ultimately syphilis will cause epilepsy, as occurs in the untreated paretic. Many developing epilepsy are those in whom life has been prolonged by therapy, who before its advent would have died.

An interesting account is given by Kopp and Solomon (1939) on the relation of the height, duration and frequency of fever to the clinical and serological results. 302 patients with various forms of neurosyphilis were given malaria with or without other methods of therapeutic fever. A subdivision of this group, 182 patients, all general paralytics, received malaria only and were under observation from 6 months to 13 years. The total amount of fever above 100° F. experienced varies widely, even for the same number of paroxysms. In the group of 182 general paralytics the amount of fever at different temperature levels, 104°, 105° or 106° and above, did not make any significant statistical

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difference in the clinical results. The best clinical results were obtained in those patients who had more than 150 hours of fever above 100°. Moreover, patients with less than ten paroxysms did not show such good clinical improvement as those who had more than ten.

Fever Therapy by Physical Methods.

An excellent critical review of developments in the treatment of syphilis with artificial fever combined with chemotherapy during the past decade is given by Simpson, Kendell and Rose (1941). The results of various workers are related, of which the more recent ones are recorded elsewhere in this paper. The author relates his personal experiences in the treatment of neurosyphilis, having tried hot baths, hot-air cabinets, electric blankets, diathermy electrical currents, and ultra high frequency electrical currents, until finally he adopted the Kettering hypertherm. Rather surprisingly it was found possible to treat general paralytics, who may be extremely uncooperative at times. Advantages adduced are that the fever is easily controlled, chemotherapy can be given almost at the same time as the fever, and finally the death-rate is practically negligible. In all methods an optimum temperature of 105·8° F. (41° C.), usually at weekly intervals, is aimed at, there being ten 5-hour sessions in all. In 1937 an experiment in the reduction in the total number of hours of fever together with a decrease in the number of hours for each treatment was made. Consequently twelve 3-hour sessions at an average temperature of 105·8° F. or a total of 36 hours were given. Serological and clinical results were equally good with this reduction in amount and duration of fever. Moreover, if necessary on account of travelling, patients could be hospitalized and given three treatments weekly for four weeks. On the other hand all local patients were treated as out-patients at bi-weekly or weekly intervals. Modifications of this programme were applied to the more debilitated type of patient.

A hypo-hyperthermia method is described by Solomon, Kopp and Rose (1941), in which the patient's temperature is lowered to 95° F. first, and then the patient is put in the inductotherm and the temperature raised to 103°–105°.

Tryparsamide.

Complications in tryparsamide therapy are described fully by Kopp and Solomon (1940), and other relevant papers are by Henrichsen (1939), Beerman and Shaffer (1940), and Downs *et al.* (1941). The most serious toxic effect is visual disturbance, and most observers agree that these changes are particularly liable to occur during the first eight to twelve injections. Kopp and Solomon advise permanent omission of the drug if disturbance of vision occurs during the first ten injections. Between 1923 and 1929 visual complications were reported in 4·5 per cent. of cases. In 13 patients in whom the drug was continued, optic atrophy resulted in 6; in 16 patients with immediate omission of the drug, optic atrophy resulted in 3 only. When visual complaints occurred after 17 to 61 injections optic atrophy did not result, even though the drug was continued in six or seven patients. Nitritoid reactions, flushing of face and neck, suffusion of conjunctivae, sense of oppression in chest, pruritus

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and sometimes nausea and vomiting are reported as being more frequent; these authors during the first five years of tryparsamide therapy, 1922 to 1926, had one case; in 1939 they reported 8·6 per cent. of their patients. The reactions last twenty minutes to half an hour; they have never been associated with optic atrophy. In this series of 829 patients with 43,308 injections, gastro-intestinal upset is recorded in 7 per cent. Here again the incidence seems to be increasing of late years; the condition was rarely seen during the first ten injections; nausea, vomiting, diarrhoea, abdominal cramps with profuse sweating are described. Jaundice, a benign type and of short duration with no sequelae, occurred in 3·6 per cent. of the entire group of patients. Batchelor (1941) suggests that tryparsamide may exert a more favourable influence when persisted with for prolonged periods and given up to a very large dosage. One of his cases received over 600 grm. of the drug and others from 300 to 500 grm. with apparent benefit.

Forman (1939) reports the results of treating 38 female cases of general paresis with continuous intensive tryparsamide and bismuth. To 32 of the patients, however, malaria therapy was also given, but the main interest lies in the administration of tryparsamide 3 grm. each week, except for two weeks twice a year. Thiobismol 0·2 grm. was given twice weekly for six weeks, alternating with rest periods of the same duration. Complete reversal of the fluid was obtained in every case, but it is noteworthy that 3 per cent. of the entire group, after showing negative results of the cerebrospinal fluid, reverted to positive.

Spiegel *et al.* (1941) give an account of a new pentavalent arsenical, aldarsone. 133 patients were treated during five years with a total of 6,702 injections. This drug was effective in the treatment of neurosyphilis, especially the meningo-vascular type. Serological improvement was noted in various spinal tests. There was no contra-indication for its use in optic atrophy—in fact visual fields showed improvement. The drug can be used continuously over a long time.

Results of Treatment and Selection of Treatment.

It is difficult to evaluate the efficacy of any one particular therapeutic agent, since a combination of one or more forms of treatment is invariably used. Much controversy exists as to whether artificial fever therapy is superior to malaria. Reports differ widely as to the relative merits of the different forms of therapy, but there would appear to be almost unanimous agreement that chemotherapy must be given as well. The aim of all therapy is to arrest the progress of the disease, in the asymptomatic neurosyphilitic to eliminate the infection, and in all forms to produce if possible a reversal of the spinal fluid. Indeed it is only by repeated lumbar punctures that one can assess the degree of improvement, if any.

Bower (1938–39) maintains that acute primary malaria with only 12–14 paroxysms is insufficient to kill all spirochaetes, and that in no instance has he seen a complete cessation of symptoms without the addition of chemotherapeutic measures. This would appear to be a sweeping statement, and does not conform to our results at the Horton malaria unit.

A serious attempt has been made by Blalock and Hinsie (1938) to assess the

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relative value of different modes of therapy. The patients under review were 300 general paralytics treated between 1923 and 1935. With all procedures it was found that a reduction in the cell count is the first change in the cerebrospinal fluid; this generally takes place soon after treatment. The globulin content becomes modified in the early months and years following treatment, but lags behind the improvement noticed in the cell count. At the end of ten years 64·3 per cent. of the males had a negative globulin reaction, in contrast to 90 per cent. of the women, whereas at the end of five years there was no sex difference. The gold curve was negative in 14 per cent. of cases at the end of the first year, in 53 per cent. after five years, and in 73 per cent by the tenth year. The Wassermann was negative in 11 per cent. at the end of the first year, and in 49 per cent. at the end of five years, when 98 patients were examined; this was increased to 89 per cent. at the end of ten years, when 28 patients were available. Still, taking all patients as a group, it was found that the reversal in serology varied with the clinical condition; at the end of a four-year period negative reactions were twice as frequent in the remitted as in the improved group. In the remitted group the cell count was normal in 100 per cent., whereas in the unimproved group this percentage was reduced to 85. Many patients who maintained an abnormal cell count during the early years following therapy had a fatal outcome.

To come to serological results in individual forms of treatment, in malaria, of 68 patients who showed clinical improvement there was a much higher rate of serological improvement than there was among 49 patients who showed no clinical remission.

Tryparsamide therapy was applied to 55 patients, 29 of whom showed clinical improvement, and 26 were unimproved. At the end of five years there was a decided difference in the improved group compared with the unimproved; a negative result was obtained in 91 per cent. for the blood Wassermann, in 82 per cent. for the spinal fluid Wassermann, and in 90 per cent. in the gold sol reaction, in contrast to 20 per cent., 33 per cent. and 40 per cent. respectively in the clinically unimproved patients.

The figures for electropyrexia are not quite so reliable, as many patients had bismuth and tryparsamide as well. 116 patients were treated, 73 being improved, and 43 with no clinical improvement. Again the percentages of negative responses are distinctly superior in the clinically improved group. At the end of four years the percentage of negative fluids for 22 patients treated by electropyrexia was 63·6, compared with 57·2 per cent. in 14 cases receiving malaria.

Combining improved and unimproved groups, it is evident that the earliest serological changes occur in the cell count of the spinal fluid, and here it is significant that at the end of three years a normal count is revealed in 92·5 and 93·9 per cent. of cases treated respectively with malaria only and with tryparsamide only, in contrast to merely 58·8 per cent. with electropyrexia only, though when combined with tryparsamide a return of 88·9 per cent. negative is obtained.

Although a most careful analysis is presented by these authors, it is unfortunate that the numbers of patients are relatively small, nor is there any

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indication of what type of paresis they are suffering from, which in most cases has an important bearing on the prognosis. The authors conclude that the safest time, if there is any, to estimate the future course of the patient's condition, from the standpoint of serology, is three to four years after treatment has been started. Serological improvement is in general independent of the clinical condition of the patient. However, a persistently positive ensemble is usually associated with a poor clinical condition. The most favourable clinical and serological results were observed in those patients who received some form of fever therapy followed by chemotherapy. A further analysis by the co-operative clinical group—O'Leary *et al.* (1940)—is presented: 1,100 patients received malaria and 320 artificial fever, both forms of treatment being supplemented by chemotherapy. Clinical remission in early or mild paresis can be obtained by either method, but as the severity of the disease progresses, there is a striking advantage in favour of electropyrexia, ten in a hundred remitting compared with only one in a hundred treated by malaria. Reviewing the serological results, the reversal rates at the end of four years were not only more rapid, but approximately twice as frequent under malaria as under artificial fever; the authors state, however, that this may have been due to more chemotherapy being given to the malaria series. Deaths, regardless of cause, provided death occurred within three months of fever therapy, were higher with malaria (13 per cent.) than with artificial fever (8 per cent.). Clinical relapses occurred in 3·3 per cent. of the malaria-treated group, and in 5·5 per cent. of the artificial fever group. The highest percentage of clinical remissions was obtained in patients treated with an average of 69 hours' fever above 101° F., of which fever time 70 per cent. was at a level above 105° F., with a maximum temperature of 106·9° F. This high temperature cannot be obtained in malaria, and the conclusion was arrived at that equally good results were obtained with an average of 44 hours of fever above 101° F., of which total time 57 per cent. was above 106° F.

A further study by Ewalt and Ebaugh (1941) was made in 232 cases of general paresis, treated alternately by either artificial fever or malaria, and observed over a five-year period. Here the authors state that the malaria series in most instances received fifty hours' fever at 104° F. or more. In the first three years patients receiving artificial fever had 50 hours between 105° and 106°, given as ten treatments of five hours each. During the last two years this was reduced to 36 hours of fever at a rectal temperature of 105·8° in twelve treatments of three hours each. No difference in results was noticed with the shorter treatments. Both treatments were supplemented by chemotherapy spread over three years, each year comprising six months of tryparsamide 3 grm. weekly, four months of bismuth salicylate 0·26 grm. weekly, and two months of neoarsphenamine 0·6 grm. weekly. Remission or improvement in this series was 69 per cent. in the artificial fever group, compared with 58 per cent. in the malaria group.

A more recent communication on the results of artificial fever therapy is given by Barton *et al.* (1942). They report that the optimum temperature should be raised to 106°, and held during the several fever periods more than 20 hours above 105° F., the recovery-rate being highest three years after treatment.

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Kopp (1942), with a series of 173 patients treated by malaria, 118 by mechanotherapy, and 81 by tryparsamide, the two first modes of therapy being supplemented by prolonged chemotherapy, reports that malaria is superior to artificial fever, while tryparsamide is superior to both; this latter statement can be explained by the fact that tryparsamide was given to very early cases with mild parenchymatous involvement and not requiring hospitalization.

Freeman (1942), in an analysis of 840 general paralytics admitted to the Worcester State Hospital during twenty years from 1920 to 1940, advocates immediate chemotherapy with subsequent fever therapy. His experience is based on different forms of therapy. From 1920 to 1924 chemotherapy was employed; from 1925 to 1929 malaria was the method of choice in conjunction with chemotherapy, while during the last decade diathermy supplemented by various combinations of chemotherapy replaced malaria. This worker reports diathermy as giving the best results.

An interesting observation is made regarding the untreated general paralytic who is physically unfit to withstand therapy. 84·4 per cent. died. Since the advent of therapy the death-rate has fallen to 28·7 per cent. It is also recorded that the "physical wreck" seen on admission is becoming rare; during the period 1920–24, 37·8 per cent. of admissions were physical wrecks and unfit for treatment; for the period 1937–40 this figure has become reduced to 8·5 per cent.

The general practice seems to be the prolonged administration of some drug such as tryparsamide following fever therapy; the period of administration varies from 20 weeks to several years. Dattner and Thomas (1942), however, raise this question. In the past at the Bellevue Hospital it was the practice to administer routine chemotherapy for one year after malaria; now a daily intensive course of mapharsen is given for ten days. Dattner states that in the Vienna Clinic chemotherapy after fever was seldom given for more than six weeks. Provided the cerebrospinal fluid is examined six months after all treatment is stopped, there is no doubt that much of this prolonged after-treatment would become unnecessary.

Artificial fever and malaria both have their place in the therapeutic programme of neurosyphilis. The death-rate of the former is lower, but with skilful management of malaria, which is equally necessary for the other method, the death-rate from malaria therapy should be greatly reduced. More patients can be treated at one time with malaria than with the artificial fever methods.

Optic Atrophy.

A review of the literature of neurosyphilis would be incomplete if the problem of optic atrophy were not included. In all contributions to this vexed problem there appears to be much confusion and disagreement. On two points, however, all workers are agreed: (1) Untreated syphilitic primary optic atrophy always involves both eyes. (2) It always leads eventually to permanent and complete blindness.

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There are many theories of the pathogenesis, which are summarized by Moore and Woods (1940). (1) Optic atrophy may be due to the co-existence of syphilis and lymphogranuloma inguinale. (2) It depends on a nutritional disturbance of the optic nerve, due to syphilitic involvement of the blood supply of the nerve. (3) It depends on a disturbance of the relationships between systemic blood pressure, retinal blood pressure and intra-ocular tension, with resultant disturbance in nutrition of the optic nerve. (4) A meningeal inflammation with development of chiasmal arachnoiditis constricts the nerve or its blood supply. (5) It may be due to a combination of nutritional (vitamin) deficiency and neurosyphilis.

There does not appear to be any good pathological support for the first two theories. Benedict and Wagener (1940) discuss the third theory relating to systemic blood pressure and intra-ocular tension, which has been put forward by Lauber (1938). This worker maintains that all tabetics with optic atrophy suffer from peripheral hypotension, diastolic at least, if not systolic as well. As a result, retinal diastolic arterial pressure, which averages about 45 per cent. of diastolic pressure, approaches the level of intra-ocular tension, with resulting circulatory failure in the optic nerve and development of optic atrophy. Consequently, as arsenic, bismuth, mercury and iodides tend to lower the blood pressure, and as it is impossible to maintain an elevation of blood pressure, the treatment of syphilitic optic atrophy should be essentially that of glaucoma, by the use of miotics. Although some good results are reported, this theory is not confirmed by other workers.

The fourth theory again is not supported by much evidence; it may explain the occasional case, and operative interference has been pursued. The post-mortem findings of such a case are described by Epstein (1940).

The last theory, that of vitamin deficiency, has considerable clinical and experimental backing. Subacute combined degeneration and vitamin B deficiency exhibit neurological signs which correspond in many ways with those seen in tabes. Experimental work in feeding young pigs on vitamin A deficient diet has produced blindness, inco-ordination and spasms. Mellanby's work (1931) is also quoted, in which he reported neurological degenerative changes in the spinal cords of puppies fed with amounts of cereal other than yellow maize and deficient in vitamin A.

Treatment and results are presented by Moore, Woods, Hopkins and Sloan (1938), and Moore and Hakin (1942). These workers are in agreement that trivalent arsenical drugs and heavy metals do not possess any direct toxic affinity for the optic nerve, as is the case with the pentavalent tryparsamide. Inadequate routine treatment (less than ten injections of a trivalent arsenical and heavy metal) results in blindness, occurring approximately within the same time period as if no treatment at all had been given; 28 per cent. are blind within one year of onset of symptoms, and all are blind by the seventh year. The most favourable results are recorded with malaria; only 9 per cent. of patients given malaria were blind one year after the onset of symptoms, 14 per cent. after two years, and 18 per cent. after three years. Thereafter for observation periods up to 15 years no additional blindness ensued.

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Experimental Syphilis and the Mechanism of Action of Malaria Therapy.

Himwich *et al.* (1940) give an account of experimental work relating to temperature and brain metabolism. The method employed was the estimation of the metabolism of the brain *in vivo* by chemical analysis of arterial and venous blood entering and leaving the brain. This study was applied to 15 patients with G.P.I. Further studies in excised cerebral tissues estimated at various temperatures ranging from 25° C. to 45° C. were made on the cerebral cortex of rats, the oxygen uptake being measured by the Warburg apparatus. The metabolic A : V oxygen differences increased irrespective of whether malaria, inductotherm or T.A.B. were used. The increase of respiration between 30° C. and 37° C. is 90 per cent., but within the range of 37° C. to 44° C. was only 66 per cent.; the damaging effect of high temperature is increased with duration. In 11 out of 15 G.P.I.'s examined the A : V difference increased by more than two volumes per cent.; in most cases the increase was greater than could be explained by the temperature. It is significant that an increase of temperature which is critical may cause an irreversible change of the thermolabile portion of enzymes, which no doubt explains the cause of death occasionally observed in hyperpyrexia.

Pötzl (1938) gives an interesting account of the mechanism of the action of malaria therapy, though no final decision has yet been reached concerning the way in which fever therapy effects its curative results in neurosyphilis. It has been claimed that the destruction of the spirochaete is achieved solely by the rise of temperature, that it is so thermo-sensitive that it is unable to survive exposure to temperature of the height and duration produced by the various methods of fever therapy. Nevertheless there is considerable evidence that other factors are involved, and that even physical methods of inducing pyrexia act by stimulating the immuno-biological responses of the patient.

Wagner-Jauregg himself favoured the immuno-biological theory, and the following experimental findings support this view:

(1) The non-specific methods of treatment of general paresis can be arranged in a definite series; the weakest are substances like milk, albumoses, phlogetan, etc.; more active are tuberculin or vaccines, and most active are those diseases produced by micro-organisms.

(2) The opsonic index for staphylococci, streptococci and *B. coli* increases in the blood during the first rise of malarial fever and in the cerebrospinal fluid during the third, and remains increased from the fifth.

(3) The histological changes found in the brain during malarial attacks are those of reticulo-endothelial activization.

(4) During the febrile attacks there is a very definite increase of peptidases in the blood, and in the intervals a very considerable excretion of these in the urine; this is a well-known result of immunization therapy.

(5) In malaria, even with high fever, there is no noticeable increase in the amino-acid content of the blood, while that of the cerebrospinal fluid is appreciably higher than in fever produced by protein substances or vaccines, although in these latter there is regularly found an increase in the amino-acid content of the blood; this indicates that in malaria there is a greater destruction of

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protein in the cerebrospinal fluid than in the blood. This increase of the amino-acid content of the fluid only occurs, however, in patients with neuro-syphilis; in patients with natural malaria or those treated for gonorrhoea it does not occur.

(6) Alterations in the permeability of the blood-brain barrier are also associated with these immuno-biological responses:

(*a*) Weil-Kafka haemolysis reaction: Sheep's blood amboceptors are present in the blood of most healthy men, but never in the cerebrospinal fluid. In general paralytics when seizures are frequent these amboceptors can be demonstrated in the fluid. After fever therapy these disappear, and their disappearance and reappearance often run parallel with remissions and recurrences.

(*b*) After injections of dead cholera, virus immunity, substances are found in the blood, but not in the cerebrospinal fluid. If the same patients are then given malaria and subsequently injections of typhus vaccine, agglutinins are found in the fluid as well as in the blood. Reversal of the procedure shows the same result.

The effect on the blood brain barrier cannot be purely mechanical, since it hinders the passage of the sheep's blood amboceptors and facilitates that of the agglutinins.

(7) There is some evidence that a brain specific antibody is produced in the cerebrospinal fluid of tabetics and general paralytics; if one uses a brain extract instead of the heart extract as antigen in the Wassermann reaction one usually obtains a positive reaction in cases of parenchymatous neurosyphilis, but never in meningo-vascular syphilis. With the heart extract as antigen the Wassermann in the fluid remains positive after malaria, but when brain extract is used it has become negative in several cases, suggesting that the production of brain specific antibodies has stopped.

(8) The leucocytosis which occurs with physical methods of fever therapy makes it probable that these methods produce changes in the organism similar to those produced by many kinds of infection and fever therapy. The leucocytosis cannot itself be the main factor, however, for malaria produces a leucopenia, and is much more effective than methods which produce a marked leucocytosis, such as phlogetan.

Prophylaxis.

Though this review of recent literature is somewhat restricted on account of many papers from Europe not being available, there are two outstanding features: (1) Neurosyphilis is a preventable disease. (2) Neurosyphilis when it manifests itself should receive immediate and energetic treatment; the choice of method should be made after a lumbar puncture has been performed, in order that the degree of activity of the disease process may be assessed. The general consensus of opinion is that fever therapy, whether malaria or artificial fever is employed, must be supplemented by chemotherapy. Prophylaxis should be started from the beginning; adequate antispecific treatment of the primary case resulting in a negative blood and cerebrospinal fluid should guarantee against any subsequent development of neurosyphilis. For the

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detected latent neurosyphilitic or the asymptomatic neurosyphilitic, fever therapy plus chemotherapy is indicated. Finally Hutton (1941) stresses the importance of the investigation of the families of neurosyphilitics, in whom the incidence of neurosyphilis is sufficiently high to warrant the investigation of all marital partners. It is in these asymptomatic cases that one looks forward to a complete cure, by applying a prophylactic course of treatment long before the grosser manifestations of disease become evident.

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CHILD PSYCHIATRY.

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A CRITICAL review of work covering a period of years, in three of which war has reduced papers from the Continent almost to *nil*, must necessarily be incomplete. Lines of investigation, however, follow a pattern which has suggested the following arrangement for this review:

(1) Normal development of the child, including the important studies of Gesell (1940, 1942) and Valentine (1942).

(2) Organic problems, increased by the work on electro-encephalography. French authors retain their prevailing interest in neuropsychiatry, while attention is drawn by many authors to the importance of minimal organic signs in apparently pure neuroses or behaviour disorders.

Linked with this, but not as yet proven organic, are the psychoses of childhood, with an undoubtedly growing interest in their recognition at an early date. Failure of development, consequent on a severe and early psychosis, reproduces the picture of organic dementia, though it may more truly be in fact a failure to exert normal function.

(3) Psychopathology has been held to include not only problems in diagnosis, and in mechanisms, but also the still confused realm of psychosomatic medicine.

(4) The war itself has its direct (and tremendous indirect) repercussion on every aspect of children's medicine. The references to direct results of bombing and shock are few, but needless to say the effects of evacuation have been widespread. Interestingly enough, the authors have discovered no references in the American literature devoted solely to overseas evacuees, possibly because the necessity of exerting supreme tact and avoiding reference to a subject fraught with such a high emotional content.

(5) New lines of investigation, particularly on the Continent, have tended to concentrate interest in various approaches to the study of personality, and their application in treatment. No attempt has been made in this study to cover the field of purely psychoanalytical work which will be found in the various psychoanalytic journals. It is interesting to note an increasing desire to use what might broadly be called the methods of normal behaviour—the child's play, his drawings, his fantasies, and to interpret these as means of access both to his problems and his adjustments.

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Section I.—Normal Development.

Gesell and his co-workers (1940), continuing their studies on the pre-school child, and collecting and correlating much previously published material, trace the growth of the normal child through the first five years. In combining a catalogue of developmental norms with a study of behaviour and of mental growth, the pattern of development is seen as a series of cross sections at different stages. Gesell demonstrates that the earlier recorded observations of infant development are "bound into an organic continuity" with the pre-school years, the whole becoming more significant by including, not only cerebral growth in terms of complexity, but also recognition of emotional problems associated with those of growth, and problems which may exist separately in mother and child.

The same approach is taken further by Gesell and Amatruda (1942), when they consider in detail development in both normal subjects and oligophrenics, relating neuro-motor patterns to normal stages in development and to abnormal events which have deflected development. A table called the "diagnostic syllabus" illustrates the extent to which earlier patterns, such as the open drooling mouth, normal at 40 weeks, are seen identically in sick children with organic lesions such as follow encephalitis.

Here, again, the role played by minimal traumata in determining "local" retardation, such as co-ordination control, is stressed, and valuable illustrations are given of the harm caused by earmarking as defective a child who is using normal intelligence to overcome such a handicap.

A full description of the technique used in making and recording observations is given. The description of the retardation imposed on pre-school children by an institutional upbringing is a classic, and a warning to all who assume that contact with other children at an early age means the same thing as companionship. No more cogent plea for normal family life has ever been written.

Valentine (1942), psychometrically considering his own children in a detached and dispassionate manner, gives a different, more philosophical history of mental development. His observations lead him to regard as important the individual variations, not only in tempo, but in the direction of interests and abilities. These tend very largely to reveal permanent traits.

Section II.—Organic.

The study of organic problems in the child's brain is chiefly of interest in elucidating such conditions as hyperkinesis, and in drawing necessary attention to the readiness with which organic causes give rise to behaviour disorders expressed in much the same way as those arising in emotional disorders. The most striking of these is a paper by Langford and Klingman (1942), describing a small group of children with cerebral tumours who presented familiar patterns of behaviour disorders. Something of the same ground is covered by Strauss and Werner (1942), who observe qualitative differences in the verbal intellectual functions. Experimental situations were devised to analyse behaviour involving the grasp of concrete relations. Three tests were used, the main nature common to all being the selection of objects on the basis of their belong-

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ing to another object, or to a pictorial situation, thus invoking the grasp of conceptual relationships. Characteristic phenomena, differentiating the brain-injured mentally defective child from the non-brain-injured normal and mentally retarded child, were found. General characteristics present were (1) forced responsiveness to stimuli, (2) pathological fixation, (3) disinhibition, (4) dissociation.

Strauss and Kephart (1940) describe an attempt to differentiate, by a new rating scale, two groups of mentally retarded children, the one with organic brain damage, the other without. They admit that the standardization of the scale is not complete, and the numbers too small to warrant conclusions, but this preliminary note suggests that by applying a rating scale, descriptive of behaviour traits, an indication of organic damage is given by those children with a high score of erratic, unco-ordinated, uncontrolled, uninhibited and socially unacceptable behaviour. Numbers tested were only 27 boys and 13 girls, with a mean I.Q. of 59 in the exogenous group and 60 in the endogenous group.

Head injuries in children were discussed by Northfield (1942). Gross brain injuries due to air-raids were described, stressing the child's greater powers of recovery, and instancing remarkable tolerance of gross injuries from which a complete recovery seemed to have been made. In contrast Lanigan (1942) describes three cases of middle meningeal haemorrhage in children, following very slight trauma, illustrating the equally important situation where the danger lies in overlooking the significance of serious sequelae. These are neurological problems, rather than psychiatric, but such cases may be among those with after-effects indistinguishable from other behaviour disorders. Zander (1940) describes the psychic sequelae of encephalitis, epidemic, post-vaccinial and post-infective, noting the high proportion of acute hallucinosis and delirium followed by minimal objective signs, often masked by behaviour disorder. It is clear that this clinical picture is by no means confined to cases of encephalitis lethargica, and many have their slight physical signs overlooked. Of such are some hyperactive children discussed by Russell (1942), citing the role played by organic syndromes, post-encephalitis, birth trauma, and in fact all conditions likely to result in minor neurological residual changes. The author regards as almost more important the part played by a restrictive environment. The role of anxiety is discussed, and case-histories are given which illustrate the importance of seeking other than organic causes and cures by physical remedies such as bromides.

Stewart (1942) describes the pathological investigation of 50 cases of cerebral diplegia, disposing of the theory that cerebral diplegia can, in all cases, derive from a uniform morbid process. The role of prematurity in such cases has probably been much exaggerated in the past. Stewart favours the theory of pre-natal origin, in line with Collier's conception of primary degeneration of cerebral neurones. Investigation of anaemia and nutritional deficiency may throw new light on this diverse clinical picture. In these 50 cases, gross pathological changes were present in all but nine brains. There was a high percentage of microcephaly, and abnormal convolutional patterns were present to the naked eye. Microscopically 8 per cent. showed no abnormality of the

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cortico-spinal path, but there was a wide variety of other abnormalities present in upwards of 3,000 slides made during this investigation.

Benton (1940) investigated a neglected subject, giving a useful list of references to the current literature dealing with the mental development of prematurely born children. He defines the concept of prematurity, quoting accepted criteria, and correlating these with other factors such as social and economic status. He quotes various follow-up studies indicating the frequency with which premature birth is associated with subsequent retardation in intellectual development. Brander makes a study of psychopathic and neuropathic traits in prematurely born children on attaining school age. He points out how frequently organically based symptoms may be neurotically determined. The study covers 376 children between the ages of 7 and 15.

Electroencephalography.

Of recent years there has been an increasing interest in the problem of electroencephalography in children. A large number of papers on the subject have been published, but care is needed in the interpretation of many of these owing to insufficient control against normal children.

The tendency of children with behaviour disorders to have abnormally slow waves in their EEG was first reported by Jasper, Solomon and Bradley, (1938), who studied a group of 71 children and found abnormalities in 71 per cent. In 1939 Lindsley and Bradley reported a small group of five behaviour problem children in each case showing EEG abnormalities suggesting an underlying basic disturbance of the central nervous system. These observations were corroborated by Lindsley and Cutts (1940), who after comparing a group of children with behaviour disorders and two control groups concluded that the characteristic abnormality was an excessive amount of 3 to 6 per sec. activity.

Grey Walter (personal communication) confirms that 60 per cent. of behaviour-problem children have EEGs which are abnormal by adult standards, and considers that the only specific abnormalities of significance are :

1. True epileptic phenomena such as " spike and wave."
2. The six cycle per second rhythm.

Brill and Seidemann (1941) investigated the effect of hyperventilation on the EEGs of normal children, and demonstrated a tendency towards dysrhythmia in the younger children diminishing with advancing age. These and other workers (Brill, 1942 ; Gallagher, 1942 ; and Strauss, 1940) have also tried to correlate the EEG findings with personality changes and other psychiatric disorders, but it is obvious that further exploration and elucidation is required before final conclusions can be reached.

Experimental Therapy.

The effect of drugs on behaviour problem children with abnormal EEGs was studied by Cutts and Jasper in 1939, who tried the effect of benzedrine and luminal on a small group of these children. Marked improvement in behaviour was observed in about half of these with benzedrine therapy, but clinical changes were not found to correlate with changes in the EEG. Luminal was found to be definitely contra-indicated. Confirmation of these findings

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was made by Lindsley and Henry (1942), who conclude that behaviour may be improved without modifying essentially the electro-cortical abnormalities.

Bradley and Bowen (1940 and 1941), in an investigation with larger groups of hospitalized behaviour-problem children, giving daily doses of up to 40 mgm. of benzedrine, found marked improvement in behaviour in a large number of these and improved scholastic performances in a small group.

Investigation by Bradley and Green (1940) showed no significant effect on performances on the revised Stanford Binet and on a battery of psychomotor tests. The apparent intellectual improvement produced in certain situations is thought to be due to the effect on the emotional attitude of the individual towards his task rather than to a specific action.

Bender and Cottington (1942) investigated the use of the drug in a wider group of psychiatric disorders, and found it a useful adjunct to treatment of the neurotic child when combined with a personal psychotherapeutic approach.

Psychosis in Children.

A study to check the validity of the statement that there is an analogy between schizophrenic and child thinking was made by Despert in 1940. Verbal productions from both groups are presented and compared, and the difference between the two with regard to thought and appreciation of reality is striking. True delusional or hallucinatory characteristics were absent in the fantasies of the 2–5-year normal group, and the responses which appeared nearest to them were found to have a strong emotional basis. This would appear compatible with the report by Bender and Lipkowitz (1940) on the hallucinatory experiences of 16 children, excluding psychotic or organically ill children, including an analysis of a questionnaire in 81 unselected children, from which it was concluded that hallucinations, or as Despert would call them, "pseudo-hallucinations," developed as an expression of a severe discrepancy between the child's own needs and drives and reality, and were a vivid form of the fantasy which is a normal process of a child's development.

An attempt to clarify the diagnosis of schizophrenia by an enumeration of the particular characteristics which specifically distinguish it from other forms of childhood maladjustment is made by Bradley and Bowen (1941). Attention was focused on such overt activities as could best be observed and recorded from an objective viewpoint, and a tentative list of eight behaviour symptoms were compiled from the prolonged observation of 14 children in a children's neuropsychiatric hospital. The behaviour traits were listed under the following headings: Seclusiveness, irritability, day-dreaming, bizarre behaviour, diminution of interests, regression of interests, sensitivity and physical inactivity.

Despert (1938) emphasizes that schizophrenia in children is not so rare as previously believed. She discusses a group of 29 children admitted to the New York State Psychiatric Institute from 1930 to 1937. Nine of these were under 7 years old on admission, the remaining 20 between 7 and 13 years. She attempts to classify them into groups according to the type of onset—acute, insidious, or insidious followed by acute, precipitated by an exogenous factor—and relates the symptomatology shown and the progress of the illness to the grouping and also to the age of the child, but stresses that the extreme fluidity

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and variability of symptoms makes classification difficult. Acute anxiety is said to be of bad prognostic import.

Work of a different type on childhood schizophrenia was undertaken by Clardy, Goldensohn and Levine (1941). They published a preliminary report as a result of a research project to determine the possibility of the presence of organic factors in these children. Seven cases with ages ranging from 9 to 13 years were observed continuously for from three to seven years, and were studied using the technique of pneumo-encephalography, electro-encephalography and psychological tests. They report that five of the seven children showed evidence of organic diseases of the brain, probably of hypoplastic basis as judged by the pneumo-encephalogram, while all seven revealed the presence of slow waves in their electro-encephalograms. They advocate further investigation along these lines.

The difficulty of diagnosing the deteriorating psychoses in children, both from each other and from other disorders such as mental deficiency which may present a very similar picture, is observed by Lay (1938). A review of the literature on child psychosis is given, with a full bibliography, followed by a description of six psychotic children seen at Guy's Hospital Clinic. Four of these cases were thought to correspond closely to dementia infantilis, owing to their acute onset, rapid progress and early age-incidence, and showed marked speech disturbance with good preservation of motor activity. The other two cases were of encephalitis and hyperkinetic disease respectively. All the cases had various features in common, and it is pointed out that symptoms previously mentioned as characteristic of schizophrenia and dementia infantilis may occur as a result of encephalitis.

Further contributions to the study of dementia in childhood have been made by Bovet (1938) and Creak (1939). The article by the former describes a single case of organic dementia of unknown origin in a child of 4 years 3 months observed over a considerable period, and contains a useful list of references on this disputed subject. Creak gives a short clinical account of various forms of deterioration coming under her own observation, and contrasts these with the major psychoses of childhood, indicating many points in common.

Interest has arisen in the treatment of schizophrenia in children by convulsion therapy. In 1938 two children at Bellevue were given cardiazol convulsions with resultant good social remissions but with very severe fractures of the thoracic vertebrae. In 1941 Cottington described a modified seizure treatment by the use of β-erythroidin, thus preventing fractures in nine out of ten cases. The clinical results were encouraging, but the final evaluation of the treatment must of necessity await further observations.

SECTION III.—PSYCHOPATHOLOGY, INCLUDING PSYCHOSOMATIC PROBLEMS.

For the purposes of clarification, this large section requires subdivision as above. It appears to us important to emphasize the fact that the dividing line between the subsections is not clear and distinct. Such an article as that of Huschka (1942) indicates very clearly how coercive bowel training of a child with all its emotional associations to the toilet trainer, in this instance a nurse, and subsequent uneasy relationships with his parents, led to a degree of con-

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stipation which was confidently declared to be organic by the pediatrician who referred the case.

Enuresis.

Work on the problem of enuresis has been undertaken in the last few years along many divergent lines. An attempt has been made at classification by various authors, but as yet no satisfactory system has been evolved, and there is a wide divergence of opinion.

The correlation between enuresis and other behaviour traits has been worked out in detail by Michaels and Goodman (1939) and published in a series of papers. They find a higher incidence of enuresis in the groups labelled psychopathic personality, psychiatric behaviour problems and mental deficiency. Persistence of the symptom is longest in these groups and shortest in normals, the psychotic group being intermediate.

Another study based on somewhat similar lines involving a far larger group of children is made by Schachter and Cotte (1941). They put forward a study of 1,962 children over three years. Fourteen per cent. of these are bedwetters at some time (cf. Michael's percentage of 19·3 in a group of 1,000); 8 per cent. are classified as chronically resistant to all treatment. An attempt is made to analyse out associated character traits and a high proportion were found to be mentally retarded, 18 per cent. to a degree not stated, while a very high proportion show minor behaviour disorder. Attention is drawn to the frequently neglected associated encopresis. The study is useful because of the large number of children investigated, but lacks the deeper insight shown by Tramer (1940), where a more detailed observation is made of the psychosomatic accompaniments, with particular reference to disturbances in the sympathetic nervous system.

A far more useful aetiological classification is given by Gerrard (1939). She gives an analysis of 72 cases. Seven of these were due to physical causes, four to faulty training and the rest psychogenic. Five of these were regressive in character, in which wetting developed as an episode of total personality regression precipitated by a new sibling. Eight were designated as revenge response cases—a regressive act on a conscious plane. One case was hysterical, resulting from identification with the father. The remaining cases fell into the class of true enuresis, that is, a symptom forming part of a neurotic syndrome. A study of the psychopathology of these patients, six of whom were fully analysed, disclosed fear of harm from persons of the opposite sex developing from three factors working together: destructive wishes to the rival parent; traumatic sexual experiences or information; and experiences of parental seduction or rejection, depending on the sex of the patient.

The importance of environmental factors is stressed by Wexburg (1940), who makes observations on the frequent association between enuresis and unfavourable social surroundings. He notes the high incidence in institutions, and advocates that treatment should aim at establishing a normal emotional relationship between the child and his environment. Both he and Mowrer and Mowrer (1938) note the relatively large group of children in whom faulty habit training is the predominant causal factor, and consider that it plays a

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large part in many others where emotional considerations are also involved. The latter authors, working on this principle, have evolved a technique of treatment based on the conditioned reflex whereby the child is awakened by an automatic mechanical arrangement set in action by the first few drops of urine voided.

A somatic manifestation of underlying emotional conflict which is rarely recognized as such is that of obesity. This point of view is put forward by Bruch (1941). The author observes that the maternal attitude to these children is ambivalent and overprotective, owing to the mother's own immaturity and insecurity, and that the home factors retard the development of the child and lead to inactivity and overeating. The child's response is primitive, with disinclination to leave the pleasures and security of infancy, and eating becomes the outlet for his aggressive impulses. The author recommends that treatment should develop more dynamic outlets for the creative drives of the child other than the static form of physical largeness.

The psychological factors associated with eating difficulties in children are the subject of a study of Lurie (1941), who analyses the social and psychological factors in 25 cases. Emphasis is laid upon the following psychic mechanisms as causative factors—the protection of the child's dependent status, revenge motives towards the mother, and self-denial to assuage guilt feelings.

General information of a widely diffused kind, including symptom formation, is given in *Die Neurosen des Kindesalters*, Stuttgart, 1939 (reviewed in the *Zeitschr. f. Kinderpsych.*), published by Emlie and written by Prof. Franz Hamburger from the Children's Clinic in Vienna. He gives a survey, with many practical suggestions, the outcome of 30 years' work in a pediatric clinic. In spite of a medical and neurological bias, it succeeds in revealing even to the lay person, many of the processes at work in neurotic symptom-formation.

Passing from the psychosomatic disorder typical for children, the other extreme is reached by those neuroses in which the picture corresponds with that seen in adults. A typical obsessional neurosis is described by Pearson (1940) with a full description of the history, symptomatology and the underlying psychopathology in an 11-year-old boy with a compulsion neurosis. Descriptions of hysterical blindness found in children are given by Wolff and Lachman (1938), and Beverly (1942) remarks on the frequency of acute anxiety states in children similar to those seen in adults. He describes 9 cases, all of whom had panic attacks. All these children were rejected or had apprehensive parents and were timid, inhibited and cowed. He notes the frequency of an alarming experience as a precipitating factor, and compares these states with the commoner forms of mild anxiety seen daily.

A study of homosexual trends in children is made by Bender and Paster (1941). 23 cases are classified into three major groups according to the age and to the psychopathology.

1. Psychosexual abnormalities in relation to difficulties in the early period of infant-parent relationship.

2. Homosexual attachments of early adolescents with symbolic and social implications.

3. Sex play between children of the same sex in pre-adolescent stage.

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Social and Environmental Factors.

Difficulties in the satisfactory adjustment of the child to his environment may be met by an increase in the fantasy life of the child, or where this fails to compensate for the inadequacies of his emotional life or to supplement his environmental experiences, an outlet may be found in socially unacceptable behaviour.

Bender and Vogel (1941), in a study of 19 cases and a survey of publications and of the use of the theme in popular literature, conclude that the creation of fantasy companions in childhood is a positive and helpful psychological mechanism used during a time of need and then given up. The form and extent of these fantasies are specific to each child, and a study of them gives insight into his problems. The various psychological mechanisms which are represented in this way include the personification of the id-impulse, ego-ideal, super-ego and aggressive and guilt trends. Therapy which includes environmental readjustment will cause the companions to disappear wholly or partially into the unconscious, from which they may reappear if the stress again recurs. Bender and Lipkowitz (1940) (*vide supra*) observe that in the same way hallucinations in non-psychotic children are formed by the child's efforts to bridge the discrepancy between an unsatisfactory reality and his own needs, the latter being increased in constitutionally or organically inferior children. They have found that the largest number of hallucinations are found in negro children, who not only have a constitutionally more facile fantasy life, but have to face greater deprivations.

Where the increase in fantasy life fails to make a social adjustment possible antisocial behaviour may develop. Yarnell (1940) describes an investigation into the psychopathology of children who start fires. Sixty cases were studied, of whom 60 per cent. were between 6–8 years, and of whom only two were girls. The children were found to fall into two groups showing markedly different pictures. In the pre-adolescent group the act was chiefly of symbolic significance as an expression of fantasy, fire being the most magic and primitive aggressive weapon within the reach of the child, a weapon used as a reaction to the deprivation of love and security which was a frequent feature of the homes from which these children came. In the adolescent group different mechanisms and reactions were found.

Stealing as a neurotic symptom was investigated by Menaker (1939). The cases studied were those of six boys treated along analytic lines and six more boys on whom the material was obtained from social workers. A study of the aetiological mechanisms revealed that the unconscious content of the symptom was an attempt to retrieve from the mother those things of which she had deprived the boy, e.g. oral and anal satisfactions and the possession of a penis.

Macdonald (1938) observes in a study of eight boys showing criminally aggressive behaviour correlated with passive effeminate personality traits that the psychosexual development had remained at the pregenital level, and notes that no satisfactory relationship was made with the father or father-substitutes, the boys developing a complex relationship to an aggressive, dominant, rejecting or punitive mother. "Children and Adolescents who Kill" is the title of a paper by Bender and Curran (1940). This includes the case-histories of two

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homicidal children and four adolescents and a study of the psychopathology involved. The mechanisms in the children and adolescents differ, the latter showing some of those typical of adult aggressive criminals. An analysis with examples is made of overt death wishes in children which arose from rivalry situations for the attention of the parent against other adults, siblings or other children. This rivalry might be accentuated by various factors such as external factors, a foster home situation, organ inferiority or educational difficulties leading to feelings of inferiority, and a tendency was noted to identify with aggressive parents and pattern after their behaviour. The authors stress the child's bewildered, violently emotional reaction following his act, and his inability to accept the immutability of the death of his victim. The frequency of the idea of death in the fantasy life of children is shown by Anthony (1940) in her book, *The Child's Discovery of Death*. The idea of death becomes emotionally charged through being brought into association with memory-complexes relating to birth and to hostility and aggression. The recognition of the inevitability of death is connected with the development of conscious logic, during which process the child has to give up his belief in his magical powers. This book is an important contribution to psychological theory.

Parent Child Relationships.

Emphasis on the role played by the child in the interplay of family relationships is made by Stern (1940) in an article which does not embody much new work, but is worthy of study. He opposes the usual psychoanalytical theory, and contrasts the peaceful family with that where strife is frequent, and where periods of negativism in the child do much to throw in fresh problems. He stresses the danger of lasting effects from such a disturbed environment, and draws attention to the difficulties imposed by such social problems as illegitimacy, believing these to be often underrated. Stern proposes a philosophy at once far deeper and yet far more elastic than the accepted "Oedipus complex," and cites Adler's work in this connection.

Periods of negativism are normally experienced in the upbringing of every child. Benjamin (1940, 1942) gives a detailed study of a group of such behaviour difficulties as tempers and negativism in a group of 167 young children observed in U.S.A. from 1931–1938, contrasting them with a similar group observed earlier in Germany. Interesting are the contrasts both in income level and size of family, the problems in U.S.A. occurring quite as frequently at high income levels, and with a heavy preponderance in the two-child family and in only children. Karl Heymann (1940) takes a similar group of older children, and notes how frequently highly intelligent children from 5–7 years become strained and anxious during the early, so-called latency period.

In contrast to the above a large number of articles have been written laying more emphasis on the role played by the mother in behaviour problem children. Field (1940) has collected information about the background and personality of the mother in a small group of cases, and has studied the influence of her personality on her choice of mate, marital adjustment and relationship with her children. Field attempts to correlate her findings with the behaviour

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manifestations in the children. The maternal attitudes in this group were in marked contrast to those in a group of schizophrenic children, and showed a high proportion of inadequate personalities with neurotic and infantile traits and consequent poor marital adjustment.

A somewhat unusual study is that of Jacques (1942), in which 1,500 consecutive case-histories were studied, in 586 of which misconceptions of the parents played a more or less significant role. Certain behaviour items were found to be particularly often misunderstood. False notions of cause and effect, of heredity and prenatal influences with misunderstandings of terminology led to an unsatisfactory attitude.

Section IV.—War.

As might have been expected, the impact of the war on childhood has produced some quite definite reactions, although many fewer than were expected. There is universal agreement that only in rare cases does the child react severely to bombing experiences. This statement must be qualified, for where there has been severe exposure to bombing, or resultant loss, say, of a parent or sibling from it, or where the child has witnessed adults being afraid, the resulting disturbances may be, at least temporarily, quite severe. Such cases are rare and, in general, evacuation has produced more troubles than bombing. Of course, very many more children have had cause to react to evacuation. Anxiety directly relating to the war is usually shown by children who have had other anxieties previously, and this is well substantiated by Gillespie (1942). Bodman (1941) points out that of 8,000 school-children, 4 per cent. showed strain in Bristol during the blitz. Even under severe stress, such as a ward of children in a hospital which received a direct hit, reactions tended to be few and brief. Of the 54 child in-patients, 61 per cent. showed a varying degree of strain for three weeks up to two months. Only 11 per cent. showed any signs after seven months, none of them being under 1 year or over 5½ years. The usual practice seemed to be for the child to reject the incident by never speaking of it for a time, while later he would formulate it in repeated recitals. After 7½ years it was more often looked on as an adventure, and over 11 years there was usually evidence of concern for others. Remarkably similar findings are recorded by Brander (1941) of Helsingfors in his observation of children in Finland during the war with Russia. He notes a few reactions of a depressive kind, which he regards as most likely to follow severe loss or deprivation, and a number of acute hysterical states, which tend to recover rapidly. He makes the interesting observation that long-term evacuation to Sweden proved more successful than moves in which the child was still easily accessible to the parent, and that compulsory evacuation is more likely to be followed by an adverse reaction than is voluntary evacuation.

The problem of evacuation in this country was discussed by Cameron (1940) and others, and a notable study was the Cambridge Evacuation Survey (1941), which provides one of the few systematic studies of evacuation. The work was done on children of school age mainly from the London area whose mothers were not in Cambridge. This selection threw the age-group as a whole significantly higher than that of the evacuated population as a whole.

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Particular attention was paid to the foster-parent-child relationship in an attempt to assess factors making for success or failure. No exact conclusions are drawn, but facts and figures are freely made use of in the various tables.

Certain basic principles emerge: the need for more preparation at the reception end, the risk of interference, intended or accidental, associated with parents' visiting day, the fitting of the right child into the right home, and the need for play centres in the more congested areas.

The problems of evacuation of nursery school children were realized early in the war. The original scheme was to evacuate no unaccompanied "under-fives." When it was found that mothers of such young children were not always content to stay away in remote country districts, the problem of war-time nurseries became an issue of national importance. The more strictly psychological aspect of the problem is extremely well and simply given in *Young Children in Wartime*, by Freud and Burlingham (1942). The harm done to the very young child who is cut off from personal individual attention, referred to above by Gesell, is stressed by these authors, and again by Bender (1941) and Bakwin (1942). *Mental Hygiene* (1942) has a whole number set aside for papers on the effects of war on the child. The articles reflect the authors' view-points rather than reporting on any specific piece of research. Again, the emphasis is repeatedly laid on the reality of the deprivation and consequent anxiety which the child is directed to face.

The *Journal of Pediatrics* contains an important article by H. Stuart, of Boston, dealing with the need for an efficient child health service, drawing a lesson from France. The article describes a visit to France under the auspices of the Rockefeller Foundation Health Committee, primarily to see to gross physical needs, food distribution, etc. The total disruption which may occur when a country is stripped of its foodstocks, means of transport and its able-bodied males could hardly occur here or in U.S.A., but faced with total war, the lesson is timely. The particular aspect of disrupted family life as dealt with by Smith, R. (1942), and Burns, C. (1941), deals with the unexpectedly frequent symptom of encopresis in evacuees, relating it to unsuitable foster homes in many instances.

On the general problem of children's reactions to war is an important article by Bender and Frosch (1942). This study of the reactions to war of children between 7 and 13 years (by questionnaire method) shows that marked anxieties, directly as a result of the war, are not much in evidence, and clinical pictures, solely determined by the war, are absent. A tendency to weave neurotic conflicts around the war situation is observed, especially in children with severe personality disorders. The war certainly has some influence on play and on the fantasy life of children. Threat of possible separation from home is the main anxiety factor, so that already insecure children are the most likely to become problems if this relationship is threatened. Finally, a very important article, summarizing impressions both from this country and from U.S.A., comes from Pritchard and Rosenzweig (1942), who discuss the different effects of stress on aggressive and non-aggressive types, seeing in this some relation to psychosomatic and psychoneurotic manifestations.

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Section V.—Personality Studies.

During the years under review a good deal has been written on the exploration of personality in childhood, by means of tests devised to release and reveal different aspects of fantasy life. The enormous field of literature on the Rorschach test is not reviewed here, although much has been done in modifying the original test, so as to apply it to children.

The classical methods of Murray's Thematic Apperception are adapted to children, and the results interpreted on broadly psychoanalytic lines by Balken and Van der Veer (1942). Excerpts are given from cases illustrating the variety of factors determining form and content of fantasies, and the ways in which they reflect past emotional conflicts and defences, and present reality situations.

Stern (1938), using the method first described by him in 1937, takes a number of formless shapes which he calls the cloud pictures and uses these as a projection method, asking the child what he sees, getting him to outline such forms as he describes, and then deliberately suggesting that he " sees " a cat. The results are noted and scored according to definite criteria. It appears from the results that personality affects the " score " far more than do age, intelligence, race or sex. Another interesting test situation is elaborated by Bourdel (1939), where the child is given a list of 438 book titles from a children's library, covering a wide range of subjects. He is asked to choose not less than 5 nor more than 10 titles, and is given the first book of his choice. While clinically inapplicable at the present time, the method is ingenious in its simplicity, and freedom from any apparent " test situation." Tramer and Baumgarten use a questionnaire method, following the lines of well-known " interest questionnaires," finding in the results clues to whatever the child feels lacking in himself.

Of the whole series, perhaps the most interesting work comes from Baumgarten. Tramer (1941), who discusses her investigations on a group of children and adolescents, who were shown a series of pictures concerned with common situations involving social relationships. One, for example, shows a child crying, another a child stealing sweets when unobserved. Adopting a standardized procedure the child is helped into the situation in such a way that he rapidly comes to identify himself with what the author aptly describes as " counsel for the prosecution " or " counsel for the defence "—in other words, children whose main concern is to restore what is lost. These tendencies are linked with such fundamental features as aggression and anxiety, and in use the test can lead very rapidly to an understanding of some of the fundamental psychic traits.

Drawing.

A study based on expression of the child's fantasies using the medium of drawing is described by Harms (1941), who by the technique to be described obtained valuable information about the inner life of the child. The article gives many interesting examples with illustrations.

The method of investigation used involved three separate elements or steps :

1. The exercise of abstraction : As in line-analysis, the child was asked to express a series of words such as dancing, happiness, depression, by a single

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line. He then illustrates his own list of words. This element was found to be too general and abstract to be used alone, and was followed by what Harms describes as—

2. The opening of the emotions: Here a series of words with either positive or negative emotional contents are put before the child, and he is asked to represent one using only colours and forms and avoiding all concrete objects. He is thus compelled to express emotions such as joy, pain or pleasure in abstract form. Thirdly Harms employs—

3. The fact test: This is designed to lead to the direct unveiling of any individual abnormality, i.e. the revealing of factual circumstances. The child may either choose a concrete topic such as a nightmare, or may be asked to represent the first thought that comes into his head following a sudden interruption.

The results obtained are of great interest, and are helpful in giving insight into juvenile psychopathology.

Play Therapy.

The uses and abuses of this term and the varying techniques employed were discussed in the Section on Play Therapy in the *American Journal of Orthopsychiatry*, 1938. In this Gerrard (1938) compared play or "superficial" therapy with psychoanalysis or "deep" therapy, pointing out that in the latter, treatment is divided into three stages: an introductory stage in which the child's difficulties in terms of specific reality situations, his conflicts and defence mechanisms, are explored with the development of a positive transference to the therapist; a second stage of the analysis proper; and a third stage of re-education in which the child is aided to use his new-gained freedom to express himself more adequately in his outside activities. She suggests that in superficial therapy the second stage be omitted with the maintenance of therapy on the level of catharsis and re-education. A description of an interesting analytic case-history of her own is published in the same volume and is discussed in full.

Levy (1939) has developed a technique which he has named Release Therapy, based on the principle of catharsis. He preferably uses this technique in selected cases showing a definite symptom picture precipitated by a specific event, and he then introduces this event into the play for the purpose of abreaction of anxiety. In addition to this specific play situation he recognizes and uses two other forms of activity: the simple release of aggression and infantile pleasures, and secondly, the release of feelings in standard situations such as sibling rivalry.

The use of created play situations in therapy is also employed by Conn (1938). In this technique a number of doll characters are used for each of which the child speaks. A description of the play interview is given in various articles by this author.

Arising out of the work of Levy and Conn, Solomon (1938, 1940) has described a form of play therapy which is a modification of Conn's technique. He, too, re-enacts situations from the child's life employing a group of dolls with the active participation of the therapist. In contrast to Conn, however,

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no identification of the dolls is made and the play remains impersonal, while a new addition is made in the form of a doll representing the therapist. The therapeutic value lies, he suggests, in the release of hostility to parents and siblings, the alleviation of guilt feelings, the expression of love fantasies, the incorporation of therapeutic suggestions and in desensitization by repetition. He reports this improvement in technique as valuable in diagnosis and therapy in the emotional problems of children.

In recent years interest has arisen in group therapy. Gabriel (1939) describes her experiences in treating a group, the constitution of which was originally unplanned and quite accidental. Her results led her to advocate group treatment as a valuable form of therapy, which should be supplemented, however, by individual treatment and by social work in the home and school. The gains produced in this form of treatment are the release of feelings and inhibitions which were more freely expressed in the presence of other children, and the realization produced that other children have similar feelings. A further advantage is in the reactivation of the family set up enabling the participants to re-enact sibling rivalries in the group situation.

A similar principle has been applied to adolescent boys and is described by Curran (1939). He describes a method of group catharsis by play-acting. The boys, a group of behaviour problem children with ages ranging from 12–14, were in-patients in Bellevue Psychiatric Hospital. They wrote, produced and acted their own plays, and group discussion was held afterward with the psychiatrist, who later followed up any leads given in individual interviews. The subjects chosen were illustrative of the boys' problems, mainly of aggressiveness in home, school or hospital, and he, like Gabriel, found that children will admit to aggressiveness more freely in the group and were able to bring up more intimate problems. In another article published in 1939 he gives a more detailed account of the organization of this group of adolescents in the ward, with a fuller report of their group activities and the opportunities for group observation.

A somewhat different type of group therapy is described by Bender and Boas (1941). This is in the form of free dancing to the accompaniment of percussion drums. The children are encouraged to express themselves with their bodies, thus forming a field for release as well as an opportunity for the therapist to gain valuable material about the child's fantasies. They found that this form of rhythmical free expression stimulated the child's primitive and deeply buried fantasies.

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DELINQUENCY AND CRIME.

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Introduction.

The modern usage of the word "delinquency" lacks precision, and some writers use it to connote all types of offences, however serious, and whatever the age of the offender, whilst others restrict its use to minor offences committed by children and young persons. A crime is described legally as an act or omission forbidden by law under pain of punishment (Harris and Wilshere, 1919), and may be regarded as conduct which the State considers to be opposed, at the time, to the welfare of the community. Kenny (1909) stated, "Crimes are wrongs whose sanction is punitive, and is remissible by the Crown, if remissible at all."

After the age of 16 years the crime rate per 100,000 of the population shows a decrease in each successive age period, and the incidence of crime is nearly eight times greater among males than females. The figures disprove the assertion of those who declare that crime is a disease, for there is no reason to believe that the number of boys who are mentally abnormal at the age of 13 is nearly double the number of those aged 19, and there are no facts to prove that eight men and youths are mentally abnormal to one woman or girl. Personal experience shows that juvenile crime is generally due to social immaturity rather than to mental abnormality, and that men commit crime more frequently than women because their responsibilities are usually heavier, and their instinctive urges more imperative (East, Stocks and Young, 1942).

Further, the records of 17,918 males and 2,749 females who were over the age of 16 years in 1932 and were found guilty in that year of offences sufficiently serious to warrant the taking of fingerprints, and who had no previous proved offences recorded against them, showed that among males 90 per cent. of the older persons and over 70 per cent. of the younger were free from any further charges during the subsequent five years. The figure for females was nearly 90 per cent. (*Criminal Statistics*, 1940). Here again it is difficult to believe that crime in first offenders is a disease, as it is usually cured by ordinary punitive measures. Repeated offences, however, are often the result of mental abnormality.

Recent observations show that the proportion of oligophrenic and psychotic offenders is less than was supposed. The number of persons received into prisons in England and Wales in 1938, the last year for which figures are available, was 50,060, of whom 0·9 per cent. were insane and 0·5 per cent. were certifiable under the Mental Deficiency Acts.* Further investigations are

* *Criminal Statistics:* The number of "receptions" is always greater than the number of different persons received into prison, since many persons after the termination of one sentence are reconvicted and return to prison the same year. Further, 8,217 of the total were committed to prison by Civil Process for failure to comply with orders for the payment of monies and for other non-criminal offences.

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required before the proportion of subnormals, psychoneurotic and psychopathic personalities in the ordinary criminal population can be accurately assessed. At the Psychiatric Clinic of the Court of General Sessions in New York City, where about 2,600 offenders are examined yearly before sentence, Thompson (1940) found 1·5 per cent. were psychotic, 2·4 per cent. were mentally defective, and 6·9 per cent. were psychopathic personalities.

Crimogenic Factors in Peace.

Recent research mainly confirms the results of previous studies. An official investigation (East, Stocks and Young, 1942) into some of the causes of crime in 4,000 male adolescents between the ages of 16 and 20 years in the London area showed that a family history of crime was reported in 5 per cent. of the cases, and was rather more frequent among those convicted of offences against property and those with more than one conviction. A family history of immorality was reported in 3 per cent. of the cases; there was no significant difference according to the nature of the offences committed, but the incidence was higher in those with more than one conviction. Quarrelsomeness was present in 3 per cent. of the cases, and lads with a record of offences against the person and against discipline alone showed a significant excess with a quarrelsome father. A family history of insanity appeared in 6 per cent. and was more frequent among those convicted of sex offences, but was not more frequent among those with more than one conviction than among the remainder. A family history of psychoneurosis was found in only 2 per cent., of mental defectiveness in 3 per cent., of epilepsy and drunkenness in each 5 per cent.

Young (1938) considers that parental alcoholism is probably more often one of several alternative agencies having an adverse influence on conduct, rather than the specific cause of crime in the offspring, though some cases may be properly attributed to its exclusive influence.

There was a family history of tuberculosis in 12 per cent. of the London adolescent criminals, of heart disease in 1 per cent., of diabetes, chorea, paralysis, spinal cord disease, hernia and deformity, and venereal disease in less than 1 per cent. in each.

Bazeley and Anderson, Ferguson and Critchley, Brain, Abt, Pinard, Ossipowa and others have noted the association of mental abnormalities with congenital syphilis. More recently Jenkins and Crudim (1941) have referred to the insignificance of acquired syphilis as a cause of adult crime. In a study of 154 children, 129 being examples of congenital syphilis and 25 of acquired syphilis, they found paresis contributed largely to expulsion from school, distractability, emotional instability, seclusiveness, temper tantrums, inattentiveness in school, excitability, destructiveness, and other minor disabilities of character. Associated with lying, and for the most part negatively associated with paresis, they found stealing, truancy, sexual delinquency, fighting and disobedience. The investigation of London adolescent criminals suggested, on the whole, that hereditary factors played only a minor part in the causation of crime, but the blood and cerebro-spinal fluids of the lads were not examined as a routine measure, and the importance as a factor of congenital or concealed syphilis was not explored.

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The London data showed no tendency for the lads to differ in stature from the general population of artisan town-dwellers of the same ages. Hooton (1939) concluded from a comparison of American criminals of all ages with a control series that the criminals had a mean stature about 1 cm. less than average. The mean weight of the London lads was well below that of London employed males of similar ages, but was consistently above the general urban industrial average. There was no certain evidence of any association of criminal tendencies and underweight. There was, however, a consistent excess in weight of lads of every age with more than one offence. On the other hand Hooton found that recidivists tended to be lighter in weight than first offenders. There was no appreciable difference between the mean chest measurements of first offenders among the London adolescents and those with a previous offence, but at age 16 lads with three or more previous convictions registered a statistically significant excess over lads with fewer convictions. Recidivists in Hooton's study tended to be deficient in chest breadth in comparison with first offenders.

Blumenthal (1941) cites diseases of the nervous system, endocrine imbalance, adenoids, and diseases of the eye and ear as factors in delinquency, and introduces Adler's theory of organ inferiority to explain abnormal behaviour in children so handicapped. Baldie (1941) reminds us that organic inferiority may result in delinquency, but frequently leads to great social achievement. In the London adolescents impaired vision occurred in about 13 per cent., impaired hearing in 4 per cent., and adenoids in about 2 per cent. Wallace (1940) found delinquents more physically mature, but presenting a greater number of physical defects than average school-children. Tucker (1940), from a consideration of the writings of various observers, concluded that there is at least some physical basis for criminal behaviour. Hooton (1939) arrived at the same conclusion. Lott (1940) found in a series of 100 court cases representing specially difficult problems that physical disabilities were present in 26 and had a very definite bearing on the behaviour of 12 of them. Hrdlicka (1939) states that there is not a single physical sign, or collection of such signs, that would justify the diagnosis of anyone as a prospective criminal.

Some correlation between the physical and psychological constitution can often be traced in criminals as well as in others, but transitional forms and mixed types confuse the findings, and probably most criminologists will agree with Landecker (1941) that the thesis of an association between physique and character should be applied with extreme caution in this field.

Among the London adolescent criminals insanity and epilepsy were present in about 1 per cent. and psychoneurosis in less than 2 per cent. Nearly 4 per cent. were mentally defective—a proportion far higher, of course, than would be found among the general population. Only 54 per cent. of those who had attended primary schools succeeded in reaching the highest class. Bagot (1941) found in juvenile delinquents in the Liverpool area that backwardness and not defectiveness influenced the incidence of offences. He criticizes the fantastic proportions between mental defectiveness and delinquency given by some observers, and refers to the recent work of Healy and Bronner, who found in "New Light on Delinquency" that no differentiation could be made between

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the mental ability of their delinquents and the controls from other members of the same families. Bagot refuses to accept the view that mental defectiveness is a notable factor in the production of crime, and declares that this is not so when measured as a proportion of the total amount of delinquency coming before the courts to-day. He believes that a contrary view is apt to mislead those who are not familiar with the subject, and prison psychiatrists in this country will agree. Bagot found recidivist juveniles were below, or very much below, the mental ability of first offenders, and considered that this was an indication of a real difference between the two groups. Among the London adolescent criminals, however, the proportion of the mentally defective was no greater among those who had been convicted more than once than among first offenders.

Arnott (1939) found in 75 children referred to a Child Guidance Clinic for severe grades of abnormal and anti-social conduct that mental defectiveness was present in 32 per cent., epilepsy in 32 per cent., organic brain damage in 12 per cent., and psychological causes in 24 per cent. Mann, C. W., and Mann, H. P. (1939), in a study of 1,731 juvenile delinquents of both sexes found nothing to prove that low intelligence is a source of juvenile delinquency.

Wile and Davis (1939), in a study of 380 children who were born spontaneously, and 120 who were born with instrumental or operative assistance, found that the children with instrumental birth appeared to show a general reduction of personal energy rather than a mere increase in sensitivity and irritability. They consider that behaviour reactions are not to be interpreted as due to shocks at birth, and refer to the previous work of Wetterdal, who found that in regard to the mental and physical conditions of children aged 12, no inferiority could be detected in those delivered by forceps when compared with those delivered spontaneously. According to Rosanoff, Handy and Plesset (1941) the part played by cerebral birth trauma or post-natal cerebral trauma, as an aetiological factor in delinquency and crime, is apparently that of impairing or destroying the inhibitory brain mechanisms which control and regulate behaviour.

Hartman (1940) found among American white native convicts that the average intelligence rating of recidivists was significantly above that of first offenders, and that differences between the two groups were present at all levels of the intellectual scale. The recidivists showed a greater proportion of superior and very superior and a smaller proportion of retarded persons. The proportion of mentally defective persons in the two groups was, however, practically the same. Tulchin (1939), as the result of psychological tests applied to 10,000 males, concluded that the proportion of criminals with inferior mentality was no higher than in the general population. The complexity of the subject is obvious. Miles (1938) asserts that criminals as a group have a lower intelligence than the mass of humanity, but they probably do not always have a lower mentality than the social group from which they are recruited. She reminds us that our measurements of criminals must be drawn from individuals who have come in conflict with the law, and their lower level of intelligence, as compared with the general population, may be

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an indication not so much of the relation of mental ability to crime as of the fact that the more intelligent criminal escapes detection.

In regard to emotional maturity, assessed by the Pressey Interest-Attitude Tests, Durea and Fertman (1941) found that, age for age, delinquent girls compare unfavourably with non-delinquent norms. This result confirmed the earlier work of Durea with delinquent boys. These observers suggest that an important element in repeated delinquencies in juveniles is an emotional immaturity, probably partly constitutional, partly conditioned by unfavourable home and neighbourhood environment, and possibly a by-product of less than average intelligence. There can be no doubt, as a result of clinical experience, that emotional factors have an important effect on recidivism in juveniles, adolescents and adults of both sexes, and often are unrelated to the intelligence level of the offender.

Adolescent instability, using the term in a wide sense, was a well-marked feature in many of the London adolescent criminals. But what often appears to be mental abnormality is found on critical investigation to be merely an exaggerated form of normal emotional reaction. The importance of the biological aspect of adolescent crime is shown by the fact that during puberty and adolescence the instinctive urges associated with sex, aggressiveness, gregariousness, acquisitiveness and self-assertiveness become more direct and persistent.

Among environmental factors, home conditions in the London adolescent criminals proved to be, as usual, of great importance. The average size of the families from which the lads were drawn—five children, including the offender himself—was appreciably larger than the average size of comparable families in the population as a whole. This confirms the results of previous workers, and is corroborated by Bagot's recent investigation. There was also a significant association between the absence of one or both parents and the commission of multiple offences against persons or property. When an older brother or sister left the home after the offender had reached the age of 14 years an increased frequency of disciplinary as compared with other types of offences was observed.

There was no reason to consider that a lad's position in the family was a factor of importance. Those under lax, careless or repressive control and those who had lived away from home showed a greater tendency to repeat offences, and they became more amenable to control as age advanced. Owing, perhaps, to the limited scope of the London inquiry, little evidence was available concerning the connection between crime and poverty. Sexual offences were less common among lads coming from the poorer districts, and these offenders came from homes with a significantly smaller number of inhabitants per dwelling than other groups of offenders. The total percentage of time spent in unemployment was not apparently greater than that so spent by the general population of the same sex and age; but at the actual date of committing their offences a large number were temporarily unemployed. There was a well-marked association between high earnings and multiple convictions, and it seems that aggressiveness, selfishness, initiative and other attributes which determine a lad to commit multiple offences sometimes favour his earning capacity.

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Bagot's juveniles were between 8 and 16 years of age. More than 50 per cent. of his delinquent families were below the poverty line, and the proportion of families of delinquents living in crowded houses was so high that these factors, and unemployment among boys aged 14 to 16, were important aetiological factors.

Crimogenic Factors in Wartime.

In peace time, crime is the resultant of numerous and combined endogenous and exogenous causes, and different individuals are dissimilarly affected. Among the exogenous causes, domestic circumstances, social and economic conditions, educational and religious influences, new legislative measures and new methods of penal treatment play their part. Many of these factors are modified by war conditions and novel crimogenic influences become operative.

A circular issued jointly by the Home Office and the Board of Education (1941) showed that for the first four months of the war there was throughout the country an increase of about 28 per cent. in the number of children under 14 found guilty of indictable offences compared with the same months in 1938. For the first twelve months of war the increase was about 41 per cent. as compared with the previous twelve months of peace. In the age group 14–17 there was an increase of about 22 per cent., in the age group 17–21 an increase of about 5 per cent., but in the age group 21 and over a decrease of about 12 per cent. during the first twelve months of war. As Evjen (1942) points out, the figures support the general contention that war increases delinquency and crime rates among juveniles and decreases the rates among adults. War, in fact, is an outstanding example of the effect of environment on the crime rate of the time.

The increase of juvenile delinquency during the war of 1914–18 was generally attributed to the absence of fathers in the fighting services abroad, and the consequent lessening of discipline in the home. In the present war evacuations and transfers, the absence of mothers during the day at war work and the interruption of school life are additional disruptive influences. Juveniles over school age in employment are faced with new temptations; they earn high wages, but lack experience in the use of money. The official joint circular states: "Poverty is sometimes given as a reason for delinquency, but under these new conditions unexpected pocket-money has brought new temptations." At the beginning of the war many clubs and other recreational facilities became inoperative and the important provisions for leisure activities were cancelled. The psychological effect of the excitement and unrest of war on adolescent boys, a newborn spirit of audacity and adventure and the black-out increase the crime rate.

The local effect of war is seen in the official figures of the Administrative County of Middlesex. The number of juveniles aged 5–17 years brought before Juvenile Courts in the area during the year 1938–39 increased by nearly 1,000 in the year 1940–41, in spite of the fact that the estimated number of juveniles at these ages in the area was reduced by 49,500 (*Report, Middlesex C.C.*, 1942).

Bodman and Dunsdon (1941) report that the number of juvenile offenders

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referred to the Bristol Child Guidance Clinic by magistrates and probation officers showed an increase of one-third in the year 1940–41 over the previous year. An analysis of the war year cases showed that 69 per cent. had committed previous offences, and emphasized the serious problems presented by the subnormal and defective group of delinquents.

Glueck (1942) warns us to view with circumspection the causal effects of war on crime, and to consider the particular circumstances of the war in question. The factors operating in the war of 1914–18 differ considerably from those which are active to-day. The factors associated with large scale air raids and the possibility of invasion were not present then, and are not apparent in America to-day. If we regard delinquency in juveniles as an expression of social immaturity we may believe with some confidence that there will be a gradual return to a more normal crime rate after the war, corresponding to a readaptation to ordinary social conditions.

After the passing of the Children and Young Persons Act, 1933, an increase in juvenile crime was observed. The reasons generally assigned for this were changes in police procedure, increasing reluctance on the part of police officers to deal on the spot with minor delinquencies, increased interest in the subject, a greater readiness to bring children before the Court, and changes in methods of salesmanship. It has been suggested (Child Guidance Council, 1941) that the most helpful lines of future treatment appear to be: Raising the school-leaving age to 15 and compulsory part-time education for older children, increased interest by local education authorities in the out-of-school hours of the children by the formation of Youth Service Squads, the establishment of Child Guidance Clinics, increased approved school accommodation and foster home placement (*Home Office Circular*, 1941).

Discussing preventive measures the official circular referred to above declared that "one of the best means of checking delinquency in wartime, as in peace, is to provide more, and more varied, social and recreative facilities to meet the needs and tastes of all sections of youthful community—indeed, this has been proved in places where such provision has been made and a decrease in delinquency has resulted—and to challenge youthful exuberance to interest itself in useful service. With goodwill and co-operation on the part of all concerned the difficulties even in wartime can be overcome."

Wartime crime in adults is encouraged by air-raids and the black-out, which provide opportunities for theft and looting, by regulations which attract black-marketing and other violations of government orders, and by the disorganization of married life which occasionally gives rise to unforeseen triangular situations and violence. Among unusual forms of crime, treason, treachery and sabotage, in particular, are incited by a state of war.

Criminal Responsibility.

Although the formula introduced a century ago after McNaghten's case has been frequently criticized, it has been propagated, as Zilboorg (1939) points out, throughout the Anglo-Saxon world, and has found its way into the criminal practice of England and America, whilst similar concepts prevail in Latin and Teutonic judicial systems. Mannheim (1938), however, reminds

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us that most continental codes acknowledge an irresistible impulse, explicitly or by implication, as a reason for imputability.

Efforts in this country and elsewhere to introduce more acceptable criteria of criminal responsibility have generally failed, and Zilboorg believes that the law relating thereto is unlikely to alter in the near future. Indeed, some may agree with him that as doctors we do not know anything clinically or scientifically about responsibility. Moreover, if a medical formula of criminal responsibility is introduced the law may insist upon a rigid adherence to its specifications, with resulting hardship to offenders and embarrassment to psychiatrists.

The elasticity of the law in this matter is clear to all. In a recent trial for murder (R. *v.* Buckfield) the judge informed the prisoner that investigation would be made by the proper authorities as to whether there was any medical explanation of his act (*Times Law Report*, 1943). Moreover, the Court of Criminal Appeal, when refusing to accept a plea of insanity which the jury has disregarded at the trial, frequently calls attention to the fact that the Secretary of State has special powers to enable him to order a medical inquiry concerning the mental condition of the appellant (i.e. under the Criminal Lunatics Act, 1884, section 2 (4)).

Notwithstanding the statutory power of the Court of Criminal Appeal to admit fresh evidence not put before the jury at the trial, and thereby to quash a conviction, evidence tending to establish a defence of insanity must be produced at the hearing before the trial court. This was shown by the refusal for time for inquiry in an appeal heard in 1942 in R. *v.* Trevor. In 1921 the Court of Criminal Appeal also refused to hear evidence of insanity when the issue had not been raised at the trial—R. *v.* Tillett. On these findings it would seem that an accused man's counsel pleading insanity must put all available evidence before the trial court, and not expect facilities for procuring such evidence after the decision of the trial court has been declared (*Lancet*, 1942).

The pressing need to-day is not a reform in the law regarding criminal responsibility, but in that of our professional standards. Gillespie (1939) has recently referred to the duty of psychiatrists to interpret the McNaghten rules literally, so long as they are in force, otherwise the witness will bring psychiatry into disrepute and not help the mentally ill in the long run. Kinberg (1941) observes that even if a serviceable definition of imputability could be made it would be of no use, and would before long be a hindrance in the rational solution of problems connected with criminal responsibility.

Cantor (1941) urges the view that none of us is normal. However this may be, an increase of psychiatric knowledge will add precision to our estimates of modified responsibility. Aschaffenburg (1941), whilst advocating an acceptance of the doctrine of modified responsibility, recognizes the difficulty in giving it effect. Crossley (1941) refers to the case of Commonwealth *v.* Cooper, in which the defendant was convicted by the jury of murder in the first degree. The question of constitutional inferiority was raised by the defence, and the judge was asked to tell the jury that if such a disorder carried with it a diminished degree of responsibility for the act the accused could not be found guilty of murder in the first degree. The judge refused to give the requisite ruling. Crossley also mentions the case of Commonwealth *v.* Trippi, against

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whom a verdict of murder in the first degree was returned, and evidence was offered that his mental age rendered him incapable of criminal intent. The judge ruled that if it could be shown by psychometric tests that the defendant was of a certain mental age, it did not entitle him to the benefit of the presumption claimed by his counsel. The Supreme Judicial Court upheld this decision on the grounds that " criminal responsibility does not depend upon the mental age of the defendant, nor upon the question whether the mind of the prisoner is above or below that of the ideal or of the average, or of the normal man, but upon the question whether the defendant knows the difference between right and wrong, can understand the relation which he bears to others, and which others bear to him, and has knowledge of the nature of his act so as to be able to perceive its true character and consequences to himself and others."

The history of the Infanticide Act, 1938, is significant. The Act of 1922 created difficulties concerning the interpretation of the phrase " newly-born," and Viscount Dawson of Penn proposed in 1938 an amendment in the House of Lords, which was adopted in the Infanticide Act, 1938, so that if at the time of the crime the balance of mind of the accused was disturbed because she had not fully recovered from the effect of giving birth to the child, or because of the effect of lactation consequent upon the birth of the child, she shall be guilty of infanticide and may be dealt with and punished as if she had been guilty of manslaughter.

The importance of the concept of a disturbed balance of mind modifying responsibility is apparent in a study by Matheson (1941), who found in 36 women charged with homicidal offences, in which the victim was under twelve months old, that only four were insane, and that insanity was more often connected with the period of lactation than with pregnancy or parturition. The concept also illustrates the readiness of the law to accept the tenets of science in the interests of justice.

The association of crime with the psychoneuroses and psychopathic personality states is important. Disagreement regarding the clinical types to be included in the latter group must be accepted, and further investigations are necessary before views on the matter are sufficiently established to enlighten generally our conception of modified responsibility. I have suggested elsewhere (East, 1943) that psychopathic personalities often seem to lie within the borderland between mental abnormality and anomalies of character rather than in that separating mental health from mental illness.

Somnambulism and hypnotism are very rarely associated with criminal behaviour. Woodbridge (1939) suggests that a somnambulist may be legally sane in California and England, and insane in Kentucky and Texas. It seems probable that if the somnambulist state satisfied the McNaghten criteria an English jury might find the offender was insane.

Older writers on hypnotism referred to cases in which juries were satisfied that crimes had been really caused by hypnosis. Wells (1941) considers that recent writers agree more with rejection than acceptance of this view, but answers the question himself emphatically in the affirmative. In his first series of experiments Wells failed to produce a criminal act by three of his subjects. He then carried out an experiment on one of his class who was

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honest and honourable, and had been previously hypnotized as well as warned that the experiment was intended to cause him to commit crime. Although the subject was determined to resist the induction of hypnosis he was, nevertheless, hypnotized and made to commit a theft.

Rowlands (1939) had previously shown that two of his subjects could be hypnotized and forced to do acts which were unquestionably repugnant to their moral principles. The subjects were made to throw sulphuric acid into the experimenter's face (supposedly, but not actually, since his face was protected by invisible glass). They did this believing that the acid would " scar the skin and put out the eyes " of the experimenter.

The question of hypnotic crime production is of more theoretical than practical interest. Wood (1938) suggests that hypnotism transfers responsibility from the subject to the hypnotist.

Electroencephalography has been introduced recently in this country in trials for murder. The writings of Finley and Macfie Campbell (1941), Hock and Kubis (1941), Davis, P. A., and Davis, H. (1939), Walter (1939) and others on different aspects of the subject seem to suggest that the EEG will be generally of little practical value to forensic psychiatry, as even specific abnormalities cannot alone provide evidence that the accused was criminally affected by his mental disability at the time the crime was committed.

Overholser (1939) recognizes the fact that we must expect the law will lag behind scientific progress, for it cannot be expected to lead; it must, if it is to be followed and respected by the majority, express the reasonably general view, but we should not expect it to ignore entirely facts of science which are widely accepted by those familiar with the data. Hulbert (1941) states, " In our culture the law is still, and we think properly, the last word in dealing with human conduct and misconduct. It is the last word but need not be the sole word." Yellowlees (1939) thinks that the legal criteria of insanity, though absurdly out of date in theory, work well in practice. Personal experience and a jealous outlook over many years on the respective rights of the public as well as those of offenders leave me in no doubt that the law on this matter is applied in England with justice, mercy and flexibility (1939).

Alcohol and Crime.

At the present time alcohol is only an occasional factor in the causation of crime in this country. In 1938 the number of persons found guilty of drunkenness was rather more than a quarter of the annual average for the years 1910–14. In a series of 100 males under my observation whilst awaiting trial for murder after the year 1918, alcohol was a dominant or contributory cause of the homicide in 19 cases (1939).

Hopwood and Milner (1940) examined the case-papers of 1,000 male admissions to Broadmoor Criminal Lunatic Asylum, covering a period of approximately 20 years. A history of excessive alcoholism was found in 131 cases, but in only 58 was alcohol thought to be the main, if not the only causative, factor for the crime. Homicidal offences among the alcoholists numbered 81, and the victims in 51 cases were their wives, paramours or sweethearts. The figures were believed to under-estimate the facts established.

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Banay (1941) found at Sing-Sing Prison that the higher incidence of assault in the alcoholic criminals was significant. In the general group of offenders, crimes against property tended to have precedence. Frankel (1939) found 19 per cent. of 721 persons committed for trial for murder in America were chronic alcoholists. Gray and Moore (1941) found among 1,637 males in the Massachusetts State Prison 66 per cent. were alcoholists. The incidence of crimes against the person, or property, or sexual crimes was approximately the same among the alcoholists and non-alcoholists. Among 928 women at the Massachusetts Reformatory for Women, Gray and Moore found the proportion of alcoholists and non-alcoholists was the same. Among the latter 75 per cent. committed crimes against public order or sexual offences, 11 per cent. committed crimes against the person, and 14 per cent. against property. Of the former 34 per cent. were sentenced for crimes against public order and sexual offences, 6 per cent. committed crimes against the person, and 5 per cent. against property; the majority, 54 per cent., had been sentenced for drunkenness. Selling (1939) found in a consecutive series of 100 recent cases of male sexual offenders that about 8 per cent. were drinking continuously and 35 per cent. were occasional drinkers. In 57 per cent. there appeared to be no connection between alcohol and the present crime.

Norris (1941) has reminded us that whereas thieves rarely blame alcohol for their offences, sexual offenders often do.

Mapother (1938), Curran (1939) and many others consider the reduction in inebriety to be due to the influence of legislative changes and altered social conditions, rather than to any possible progress of psychiatry in the treatment of individual patients. This view is confirmed by the experience of prison psychiatrists in this country. Granting that most alcoholists suffer from nervous ailments, and that psychiatrists cannot remove the psychopathic conditions underlying many cases of drunkenness, Hall (1941) questions whether legal punishment is useless. He believes that we must recognize the fact that there are distinctive legal goals which may be at variance with scientific dictates, otherwise medical discoveries and propagandization may do more harm than good.

Mental Abnormality and Crime.

Formerly studies of the association of crime with mental abnormality were largely concerned with intellectual processes. A change-over was observed when the relative emotional reactions were investigated more thoroughly. Future research into the relationship between volition and crime may enlighten some of the problems which arise in connection with unusual forms of criminal activity.

Draper (1939) considers that mental abnormality is responsible for about one-fourth to one-third of criminality, and that the mentally ill who commit crime come from the 2 per cent. of the general population showing mental abnormalities. He believes that many more criminals are drawn from the class who are mentally abnormal in proportion to their percentage of the general population than from the rest. It must be admitted that some degree of speculation enters into many such estimates. The number of prisoners who

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are certified as insane or mentally defective in this country is known, but there are no precise official figures to show the number of subnormal, psychoneurotic and psychopathic personalities in the prison population. In an investigation at Wormwood Scrubs Prison, East and Hubert (1939) considered that the "normal" group included at least 80 per cent. of the receptions into prison in England and Wales.

Psychoses.—The alcoholic psychoses formerly made up a large proportion of insane offenders. In the year ended March 31, 1907, there were 246 cases of delirium tremens treated in prisons in England and Wales. In the year 1936 there were only seven cases (1938). Other alcoholic mental disorders also are seen less frequently in prisons than formerly.

Any attempt at precision when estimating the diagnostic types of psychiatric prisoners before trial is open to the criticism that reliable case-histories are seldom available and the previous mental histories of the patients are often unknown. Moreover, a criminal setting itself often increases the difficulties of accurate diagnosis.

Masserman and Carmichael (1938) found in 100 patients with an average length of stay of 24 days in the Psychiatric Division of the University of Chicago Clinics, who were re-examined a year or more after their discharge, that a major revision in the diagnosis had to be made in more than 40 per cent., and that the diagnosis tended to shift from neuroses to mixed forms of psychoses rather than in the reverse direction. Cameron (1941) inquires whether it is possible for us to think in terms of setting up Departments of Behaviour rather than Departments of Psychiatry, and in terms of teaching the fundamentals of human nature in place of the data of rather artificially classified diseases.

Interesting data regarding criminality in male psychiatric patients are presented by Erickson (1938), who found among 1,262 male patients in Eloise Hospital 25 per cent. had a history of criminality, despite the practice of sending mentally disordered criminals to special institutions for the insane criminal, and the difficulty involved in obtaining complete case-histories. A study of the types of offence disclosed a high frequency of sex crimes, and of other crimes against the person, the incidence being 20 per cent. for the sex crimes and 45 per cent. for the others, as compared with 10 to 15 per cent. each for the general criminal population.

In England and Wales the highest proportion of insane offenders is found among homicides. During the ten-year period 1929–38 of 460 persons committed for trial for murder of persons aged one year and over 90 were acquitted. Of the remainder, 223 were found to be insane and 164 were found to be guilty without insanity (*Criminal Statistics*, 1929–1938).

During 1938 there were 3,303 cases of attempted suicide brought to the notice of the police, and 586 came before the courts. Of 12 children and young persons under the age of 17 charged with this offence before a juvenile court, 10 were found guilty, and 1 was sent to an approved school; of 568 adults and adolescents over the age of 17 coming before a summary court, 530 were found guilty, and 24 were sentenced to short terms of imprisonment. At quarter sessions and assizes 6 persons were found guilty of this offence, and 1 was sentenced to imprisonment (*Criminal Statistics*, 1938). The majority of these

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offenders cannot be certified as insane, and some would not remain under voluntary treatment. I have supported elsewhere on medical grounds the penalization of attempted suicide offenders in special cases. Commenting on this, Mannheim (1939) says that it ought to be made as clear as possible that by accepting this view as a basis for the present attitude for the penal law, we are adopting a conception of punishment which replaces the old idea that even a reformative method of punishment must be an evil by the other conception that it may be a purely beneficial treatment.

The prison psychoses form a well-defined group of reactions which may be described as depressive, impulsive, deteriorative, hysteroid, paranoid and feigned. The form of the psychosis appears to depend upon the previous ersonality of the offender as a rule. But looking back it seems that the cases seen in prisons in this country in the earliest years of the century were often directly due to the harsh penal discipline of the period, whereas to-day they are affective reactions to less obvious disturbances of consciousness in psychopathic persons. Karlan (1939) finds the symptoms may include depression, excitement, confusion, paranoid delusions, hallucinations and compulsive acts. He found in 46 of 50 cases, i.e. 92 per cent., that a definite relationship could be detected between the psychotic symptoms and the previous personality as shown by the previous history, or the temperament scale, or both.

Mental defectiveness.—As already stated, the association of mental defectiveness and crime is less than has been sometimes supposed, and this is undoubtedly due in some measure to more effective extra-mural ascertainment. There is, however, no ground for complacency, and constant vigilance from social and educational workers, psychiatrists and eugenists is necessary.

The subnormal group of offenders affords a wide field for medico-legal research. Rogers (1939) points out how the whole subject of the clinical treatment of the problem child including its delinquency aspects is as yet only in its infancy, and that we must have many therapeutic failures before the subject is on a really sound and successful foundation.

Psychoneuroses.—There is little doubt that the psychoneuroses are associated with crime more frequently than is sometimes supposed. Syz (1938) refers to the fact that in many cases when the personality development leads to crime there appears to be a close relation to mechanisms described in neuroses and psychopathic personalities as repression, instinctual frustration, hostility, anxiety and symptom formation. He considers the criminal act, like the neurotic symptom, may often result from conflicting and poorly developed personality tendencies as an expression of rebellion or dependence, or as the equivalent of a neurotic compromise formation. Oltman and Friedman (1941) quote Alexander, F., and Healy, W., who state in " Roots of Crime " that the chief difference between neurosis and criminal behaviour is that the emotional conflict in the former results in symbolic gratification of unsatisfied urges, whereas in the latter it leads to overt misdeeds.

East and Hubert (1939) noted in remand prisoners that any hysterical reaction is likely to be much increased by unskilled psychiatric examination at this time, especially if the accused believes that illness may be a defence or an excuse at his trial. It was considered that the prison environment predis-

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poses towards the appearance of hysterical symptoms in a suitable subject, but acts against their continuance except in the very severe case when reactive prison psychoses may occur. The hysteric easily embarks upon a line of behaviour through motives of which he is not clearly aware, and is therefore unable to assess their real value to him. He may thus start, perhaps in childhood, antisocial behaviour to cover up feelings of inferiority, or in attempts to gain some ill-defined emotional goal, and by habit and circumstance, continue throughout his life as he began.

The rarity of true obsessional activity among criminals is attributable to some extent to the fact that the obsessional personality leads the individual to worry to excess over all rules and regulations.

Anxiety states are particularly likely to result in crime if the offender lacks resilience to situations which require him to adapt his emotional reactions to present necessities. Although imprisonment tends on the whole to reduce anxiety because the result of the trial is no longer in suspense, and the routine life of a prison with a minimum of responsibility and freedom from making decisions has a calming effect, nevertheless, apprehensions regarding the future and similar factors may lead to anxiety states in those who are predisposed.

Neurasthenia is a comparatively infrequent cause of crime, but the accompanying irritability, hypersensitivity, depression, fatigue and slight depersonalization may be associated with criminal activities on occasion.

Psychopathic personalities.—Maladjustment at the socio-psychobiological level is frequently expressed by criminal behaviour in psychopathic personalities. Over-simplification on the one hand and over-elaboration of the clinical types on the other tend to confuse the problems arising from the association of this form of sociopathy with crime. The recent observations of Henderson (1939, 1942), Petrie (1942), Curran (1942), Hulbert (1939), Overholser (1938), Chornyak (1941), Cudmore (1939), Ruskin (1941), and others encourage the view that future study will clarify our ideas regarding the various clinical types, and result in more progressive measures for dealing with their antisocial effects.

The criminal psychopathic personality may be defined, tentatively, as a person who, although not insane, psychoneurotic or mentally defective, is persistently unable to adapt himself to social requirements on account of quantitative peculiarities of impulse, temperament and character which may require specialized medical and rehabilitative treatment, instead of, or in addition to, the ordinary methods of punishment before his social reclamation is effected.

The most important clinical types associated with crime are the cycloids, schizoids and paranoid personalities, some sexual perverts, alcohol and drug addicts, unstable personalities, psychologically maladjusted persons, and constitutional psychic inferiors.

Overholser (1938) observes that before the law can be expected to recognize the group as calling for specialized treatment, it will be necessary for psychiatrists to come to a better agreement on the delimitation of the group. The statistics that have been published by psychiatric clinics in courts and correctional institutions show such wide discrepancies that it seems likely the basal difficulty is in the criteria of diagnosis.

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Hulbert (1939) considers that psychopaths are born below standard in function and adaptability. He prefers to classify them into types rather than into large groups.

Henderson (1939, 1942) considers psychopaths in the following categories—the predominantly aggressive, the passive and the creative. The creative psychopath, although important socially, is not often arrested for crime, and the grouping seems too wide for practical purposes in prison and forensic classification.

The constitution of the psychopathic personality, being incapable of reconstruction, can at best only be modified, and treatment is often necessarily restricted to this end. It is, however, important for the psychopath to realize that his over-valuation of self is some measure of his inferiority, that society must insist upon a limit to the behaviour it will tolerate, and that excuse and subterfuge will not prevail against the wider interests of society.

Treatment.

Although the scientific treatment of delinquency and crime is concerned with a comparatively small group of offenders, they are more socially inefficient, dangerous, incorrigible, and in need of help than others. The importance of treatment afforded by Child Guidance and Psychiatric Clinics in cases of incipient delinquency and crime can be no longer questioned, but Penrose (1939) points out that the development of services for the control of the anti-social elements of the community depends not only upon the current social standards, but also upon the financial resources of the State or district concerned.

The public has long been concerned with sexual offences, and this is due in recent years, in some measure, to over-emphasis regarding the value of medical treatment in this class of offender. Bowman (1938) refers to the fact that the public demands some simple and easy formula for dealing with this problem, but no such formula exists. The surgical treatment of sexual offenders has been recently discussed by Kopp (1938), Naville and Dubois-Ferrière (1941) and others. So far, the known facts have not encouraged public or medical approval for the adoption of sterilization as a method of treating sexual offenders. The role of sex hormones in relation to homosexuality has been considered recently by Reiss (1940), Barahal (1939), Rudolf (1941), Wright (1939), Allen (1940) and others, but the practical effect of hormone therapy as a remedy in criminal cases requires further exploration. Psychotherapy is sometimes useful in specially selected cases, but the psychopathic sexual offender, like many others, often fails to profit by any form of therapy.

Whilst recognizing the value of the psychiatric interview in relation to the aetiology of criminal behaviour, it must be granted that it would be a great disservice to psychiatry and the psychological treatment of crime if the limitations of the latter were not frankly acknowledged.

There is much truth in Wertham's (1938) statement that the largest number of sexual offenders belong to a group between crime and disease, and that if we treat them merely according to medicine, or merely according to the criminal law, we treat them as something which they are not, and that can help neither them nor us.

We should insist that others, as well as ourselves, recognize the fact that

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among criminals, as in the general civil population, some persons are constitutionally unable to stand alone. At one end of the scale the ordinary offender is appropriately treated in a modern penal institution, at the other end psychotic and defective offenders receive treatment in mental institutions. Between the two extremes a small group of offenders require custodial care for the protection of society in an establishment which is neither a prison nor a mental hospital, but has some of the features associated with both.

East and Hubert (1939) envisage an establishment which would serve as an investigation, training, treatment and research centre, and as a colony for certain types of offenders who are unable to adapt themselves to ordinary social conditions, and for whom reformative measures, however specialized, seem useless, and the severity and hardship of ordinary prison life inappropriate.

Conclusion.

We are concerned, as never before, with the training, treatment and rehabilitation of offenders, and Warson's (1941) statement that criminology and psychiatry are moving together is particularly true of Great Britain to-day. Future advances in the scientific approach to crime and the scientific treatment of mentally abnormal offenders will depend upon the carefully controlled researches of social workers, psychologists and psychiatrists attached to intra- and extra-mural centres. They will be further promoted when the provisions of the Criminal Justice Bill, 1938, are legalized. But this is not enough. A large scale orientation must enable the public to recognize with v. Hentig (1938) that deterrence is a principle to be handled with the utmost care. Above all, let us remember that the prevention of delinquency and crime, together with the treatment and rehabilitation of offenders, are problems in social hygiene which demand of their protagonists skill in the practical art of medicine, and fidelity in the application of scientific methods.

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MENTAL DEFECT.

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I. GENERAL.

A SCRUTINY of the papers published during the years 1940–42 and, indeed those published in 1939 and 1943, reveals an increasing trend towards clinical inquiry. Few articles are to be found in which it is assumed that mental deficiency is itself a simple concept, about which little remains to be discovered, and writers are now more cautious in suggesting the best methods of control and treatment than they were wont to be ten or twenty years ago. It is even realized that there are no fully satisfactory methods of describing what is meant by mental defect. Kuhlmann (1941) gives this definition: "Mental deficiency is a mental condition resulting from a subnormal rate of development of some or all mental functions." The specific functions which are weak or strong in a given case are determined by tests and other observations. As Doll (1941) points out, there seems to be no escape from basing the diagnosis of mental deficiency upon a variety of different criteria, the main symptom still being social incompetence. Standards of social behaviour at different ages have been incorporated by Doll (1942) in the Vineland Social Maturity Scale; he recommends its use in classifying cases for training. The problem of deciding what constitutes mental defect is acutely brought out when differences in education or culture have to be considered. Sparling (1941), for example, showed that American Indian children, whose mean Binet I.Q. was on the borderline between normality and defect, had a mean I.Q. of 108 on the Porteous Maze test. In New York State, Malzberg (1943) found that even allowing for educational differences, mental defect was commoner among negroes than among whites. Nevertheless, as shown by Zubin and Scholz (1941), recognized mental defect (judged by the number of admissions to institutions) is commoner among whites than among negroes in the Southern States. This effect is partly due to the fact that more attention is paid to problems of mental defect in predominantly white than in predominantly coloured populations. Conversely, prisons contain unduly high proportions of coloured inmates according to both North American and South African statistics (Penrose, 1943). The question as to how far mental defect is a contributory factor in cases of crime has received attention from Frankel (1939), who reported that 15 per cent. of 1,000 murderers came into this category, and that the mean mental age for 722 of such criminals was 11 years. Among 309 adolescent delinquents, Stefanescu-Goanga (1939) found 99, or 32 per cent., mentally defective; 47 per cent. of the children committed for homicide were in this category, and 34 per cent. of those committed for theft. Selling (1942) has

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investigated the degrees of intelligence in offenders under Road Traffic Acts, and finds that although uncomplicated defect is compatible with safe driving, many accidents are caused by emotionally unstable cases with subnormal intellectual capacity, and that such people should not be allowed to drive motor vehicles.

Uncertainty as to the precise nature of mental defect has tended to make plans for eugenic eradication of the disability seem increasingly utopian. Wholesale sterilization of defectives has been somewhat discredited as a panacea by virtue of its close association with the methods of dictatorship. Moreover, a review of the prospects of making any practical diminution in the frequency of hereditary factors responsible for low intelligence by sterilization programmes, planned or already in operation (Price and Halperin, 1940), leads to pessimistic conclusions. Assortative mating is seen to be capable of producing changes which are out of all proportion to the possible effects of sterilization. The public, it is held, need to be more fully informed about the absence of relationship between sterilization and taxation. Advocates of preventive eugenic measures, including euthanasia, however, have received recent support from Kennedy (1942), who holds that idiots and imbeciles are not worth the educational training bestowed upon them, and recommends euthanasia—" a soft, gentle-sounding word "—for those hopeless ones who should never have been born—" Nature's mistakes." The converse of this view is urged by Kanner (1942), who emphasizes that nearly all the harm done in the world is attributable to people who are normally intelligent but distorted in mind or grossly ignorant. Too much emphasis is placed upon the I.Q., he thinks, as a discriminating tool. Society derives great benefit and could derive much more from the training and allocation of defectives and, in any case, idiots have committed no sin in being born, and have just as much right to enjoy life as those better endowed with the I.Q. commodity.

II. Genetics.

A summary of the position of human genetics at the beginning of the period under discussion is to be found in Roberts's textbook (1940*b*); other authoritative accounts emphasizing the biochemical, biological and psychological aspects of heredity have been given by Haldane (1941), Snyder (1940) and Burlingame (1940) respectively. The advances made in animal and plant genetics in the last few decades have totally transformed the basic conceptions of heredity to which any plausible theories of inheritance of mental defect must conform. Phrases like " progressive degeneration of the stock through inbreeding " and " neuropathic taint " are becoming less frequent in the literature as it is becoming realized that accurate descriptions are necessary. Moreover, as described by Muller (1941), the gene or basic unity of heredity has been clearly shown to have physico-chemical reality, and has ceased to be merely a convenient descriptive concept. Among the most important recent basic investigations into human heredity is the study on the frequency of consanguineous marriages in England compiled by Bell (1940). It is now possible to determine with a much greater degree of confidence than formerly whether or not, in a given series of cases, consanguineous parentage occurs more frequently than in the general

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population. This information often proves to be of great value in determining the exact mode of inheritance of particular conditions. It also enables studies to be made which indicate, in a general way, how far recessive factors contribute to the aetiology of mental defect. Duff and Dingee (1941) surveyed 2,082 institutional cases of mental defect of all grades and found consanguineous parentage in 60 instances, which corresponds to a rate of 2·9 per cent.—a figure in agreement with that found in previous surveys, and significantly higher than that found by Bell for patients in general hospitals, namely, 0·6 per cent. Still higher consanguinity rates were found in the sub-group of cases at the idiot level and in the clinical groups, spastic paralysis and endocrine dysfunction. The offspring of incestuous parental unions tended to be found among high-grade cases of defect, probably because such unions occur almost exclusively among persons of low intellectual capacity. More detailed investigation of the families in which such unions occur might give valuable genetical information. The suggestion has also been made that the search for consanguinity between grandparents on one or other side of the family may be useful in the study of aetiology of defects because of the possibility that relatively inbred stock may conceal defective chromosome structures (Penrose, 1940), which may manifest themselves when there is outbreeding.

The extensive work of Murphy (1939) on the relationship between maternal age and the incidence of congenital malformations has been supplemented by other studies. Dayton and Truden (1940), in a survey of 23,422 families examined by mental health clinics in Massachusetts, concluded that the maternal age of 35 to 49 years was an unfavourable factor in the child's mental development, especially at the dull normal and imbecile levels. Primogeniture is also still to be reckoned with as a possible cause of malformation of the nervous system (Penrose, 1939). The question as to how far such unfavourable maternal influences can be nutritional has been investigated by Murphy and Bowes (1939), who concluded that, though inadequacy of diet was found more frequently among mothers of cases of congenital malformation than in a control group, it was doubtful whether either poor diet or anaemia in the mother was a predisposing cause.

The discovery (Murphy, 1939) of malformed offspring born to mothers who had been subject to pelvic irradiations during pregnancy has led to much subsequent speculation on this question. Maxfield (1941) described a case of a microcephalic imbecile born to a mother aged 42 years, who had received radiation therapy for uterine haemorrhage up to a time within four months of the birth, but did not commit himself on the question of causation of the defect. Another somewhat similar case was reported by Murphy, Shirlock and Doll (1942), in which pelvic irradiation had been applied in the third month of pregnancy with a view to producing an abortion. The child, at 14½ months, was undersized, asymmetrical, and had spastic paralysis of the limbs; mental development was retarded and the head was small. The cases tend to confirm the view previously put forward by Goldstein and Murphy (1929) that irradiation during pregnancy is very harmful to the foetus.

On the question of the degree to which intelligence can be said to be inherited, the continuation of the analysis by Roberts (1940) of data, obtained in a com-

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prehensive survey of 3,362 children in Bath, give rise to some important figures. The degree of likeness of sibs in respect of mental ability measured by the correlation coefficient was +0·535 for 608 pairs of sibs. Parents probably also resemble one another closely in degree of intellectual capacity, and this has the effect of raising the coefficient of likeness between sibs. If a fairly high degree of interparental resemblance is allowed for, the observed fraternal likeness is of the correct order of magnitude to support the assumption that multifactor inheritance is largely responsible for the determination of intelligence level, as measured by the Otis or Binet tests. Other recent investigations bearing on the same problem include that by Preda and Mates (1939), who found a close association between I.Q. level of children and paternal mental grade as judged by occupation. On the whole, evidence continues to increase in favour of the view that the genetic background of intellectual defect is multifactorial, when the special clinical types are excluded. Brugger (1941) still holds, however, that uncomplicated defect is not a graded character, but a genetic entity which is recessively determined. Goddard (1942), in a reply to criticism of his work on the inheritance of feeblemindedness and the Kallikak family, implies that he still believes in the essential soundness of the recessive hypothesis, and the classification of persons either as normal or defective without intermediate descriptions. Frets (1940) emphasizes the importance of heredity in mental defect, but doubts the validity of the recessive hypothesis to explain 39 extensive pedigrees. That hereditary constitution is not the only factor which determines intelligence level has been clearly demonstrated by Hobbs (1941), who reported two uniovular female twins, one normal (Binet I.Q., 105), and the other defective (Binet I.Q., 57).

An interesting discussion on the genetical relationship between mental defect and psychosis is provided by Kallman and others (1941). The writers hold that the view often found in psychiatric literature that schizophrenia and defect have a common genetic background is false. After presenting several cases of twins they conclude that these two conditions are due to specific and unrelated factors. Often the more intelligent of a pair of twins is the more psychotic. Rosanoff's conception of "unspecific inheritance" as the cause of inherent cerebral vulnerability is repudiated, and the practical importance of distinguishing between mental disease and mental defect is emphasized. Brown's records (1942) of the relatives of psychoneurotic patients did not indicate the likelihood of any genetic relationship between defect and mental disorder; only four of 492 sibs of psychoneurotic patients were rated defective. Psychopathic personality, according to Humphreys (1940), occurs in defectives just as frequently as it does in normals and in persons of superior ability; consequently, special institutional supervision should be made for psychopathic defectives.

III. Clinical Types.

With respect to some of the specific diseases which are frequently associated with mental defect, there are numerous recent investigations to report. Haldane (1941) analysed the data collected by Bell (1939), consisting of families in which there was more than one case of spastic diplegia in the sibship. A recessive type of inheritance was shown to be prevalent in rather more than

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one-quarter of the cases studied. Furthermore, the tendency in these families for those affected to be all boys or all girls was so marked that Haldane postulates that the recessive factor is partially sex-linked. Dominant spastic diplegia does not appear to be partially sex-linked, however. These interpretations need to be evaluated in relation to the different clinical types of familial diplegia. An investigation of the cerebral histology of 50 cases by Stewart (1942) revealed that no invariable or specific changes are associated with diplegia. In four instances no abnormality could be found in any part of the cortico-spinal path, while in others there were gross pathological changes. The brains were mostly under the normal weight. Though prenatal origin must be postulated, there is no single common cause for cerebral diplegia, and in some cases it may be due to foetal malnutrition. Two cases showing diplegia associated with microcephaly were examined in detail histologically by Benda (1941).

Microphthalmia associated with mental defect, usually low grade, is not very uncommon. It is a condition which lends itself readily to genetic investigation because of its easy recognition. A sibship containing four affected sibs, two imbecile twin males, and a male and female of normal intelligence was reported by Kallman, Barrera and Metzger (1940). The parents were of Persian origin and they were second cousins. This recessive type of inheritance contrasts with the sex-linked type exhibited by the cases described by Roberts (1937), one of which died and was examined, post-mortem, by Whitnall and Norman (1940). The optic nerves, chiasma, tracts, lateral geniculate bodies and one corticovisual area were found to be grossly deformed and the eyeballs completely disorganized.

A sibship containing six cases of juvenile amaurotic idiocy was described by Jervis (1941), and the age of onset of symptoms in all instances was between 5 and 6 years of age. Norman and Wood (1941) described a congenital form of the disease in which the only child of unrelated parents survived but a few days after birth; the brain showed extreme microcephaly with a lipoid dyscrasia and pachygyria. Cases of the dystrophy named "gargoylism" by Ellis, Sheldon and Capon (1936) have attracted attention from many observers. Ross, Hawke and Brown (1941) gave descriptions of four cases. Jervis (1942) described a family in which the cases were somewhat atypical, and argued that the disease was closely related to amaurotic idiocy. Halperin and Curtis (1942) have shown that gargoylism is due to a single recessive gene. Osteochondrodystrophia deformans (Morquio's disease) was noted in two sibs with related parents by Farrell and others (1942), and in three patients by Einhorn, Moore, Osborn and Rowntree (1941). The family described by Shafar (1941), who relates an irregularly dominant type of brachyphalangy to Morquio's disease, is of considerable genetical interest. Here the condition was mild and evidently heterozygous, whereas in Morquio's disease it is severe and homozygous. Possibly the union of two brachyphalangeous parents would give rise to osteochondrodystrophic children. Two defective male sibs with anhidrotic ectodermal dysplasia were reported by Halperin and Curtis (1942), and analysis of cases in previous literature showed sex-linked inheritance to be probable.

A remarkable paper describing hereditary examples of lumbosacral syringo-

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myelia by Van Epps and Kerr (1940) shows that altogether now 71 familial and 9 sporadic cases have been reported. The condition is only rarely associated with mental defect, but may be of value in studying the mutation-rate in man. Cases of hyperostosis frontalis interna continue to be discussed in the literature, though the origin of the disease is still obscure; Stewart (1941) shows that the new bone formation in the skull is not due to brain atrophy. Ferriman (1940) discusses the irregularly dominant type of inheritance found in oxycephaly and acrocephalosyndactyly. Both diseases, which are significantly associated with mental defect, are often sporadic in occurrence, especially acrocephalosyndactyly. Mental defect associated with cutaneous naevi may occasionally appear in more than one member of the same family. A sporadic case was recently described by Ironside and Hill (1941). Full references are to be found in the paper by Nussey and Miller (1939). Multiple angiomata affecting the retina and cerebellum (Lindau-Von-Hippel disease) in four patients, one of whom had an affected parent, were described by Craig, Wagner and Kernohan (1941). Here, again, some cases may be due to new mutation. Disagreeing with the views of some investigators who have considered myotonia atrophica to be inherited as a simple dominant character, Maas (1937) and Maas and Paterson (1943) point out that there is a large variation in degrees of severity in affected members of the same pedigree. This disease is evidently commoner than is usually supposed. The writers infer from analysis of material, which covers 94 families, that the worst affected cases appear in the latter part of the sibship, and they maintain the viewpoint, now generally discredited, but also held by Ravin and Waring (1939), that the disease tends to become earlier in onset in each succeeding generation.

Many aspects of the subject of mongolism continue to afford scope for the research worker. It is becoming more widely accepted that two unknown factors, one associated with advancing maternal age rather than with birth order, and the other a genetic influence, irregularly dominant and possibly a chromosome abnormality, are aetiologically significant. Jervis (1942) gives a very useful summary of the literature on mongolism over the last decade, but does not commit himself on the question of aetiology. Studies of twins have so far revealed that in all, certain cases where both twins are affected, they are uniovular. To the possibly exceptional cases of mongol twin pairs, which have been recorded as dizygotic and both affected, Jervis (1943) has added another pair. There, however, as in McKaye's cases (1936), a main physical difference noted was eye colour. Jervis's cases had separate foetal membranes and placenta, but were of the same blood group B. In contra-indication to this, in the pair described by Gordon and Roberts (1938), the twins were undoubtedly binovular, but quite atypical with respect to mongolism. A study by Ford and Frumkin (1942) demonstrates that finger and palm prints can be valuable aids both to diagnosis of monozygosity and understanding of the nature of the disease. Thus, the patterns found on the hands of both cases, in a pair of twins reported, were very similar to one another, and were of types found much more frequently on hands of mongolian imbeciles than on those of normal persons. These unusual patterns, first discovered by Cummins (1936), are considered to indicate a disturbance of growth at a very early stage in

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development. Wolff and Rollin (1942) have attempted to relate the grosser abnormalities in the creases of mongol palms to different types of personality shown by the patients.

Further information about the nature of the growth disturbance characteristic of mongolism has been obtained by Benda (1939), who analysed the results of measuring a series of cases from 2 months to 34 years, and showed that the skull growth is retarded with especially early arrest of growth in the basal structure. Benda (1939) also holds that there is some evidence of foetal hyperthyroidism and subsequent involution of the thyroid gland in mongols. He also found an excess of eosinophilic cells in the pituitary glands. Benda (1940) reports further that the maldevelopment of the brain in mongolism is due to hormonal dysfunction. A number of biochemical studies were made by Bixby (1939, 1940, 1941, 1942), and, according to her, protein or mineral metabolism are ruled out as sources of abnormality in mongolism. Blood or serum cholesterol, plasma fibrin, serum albumin, globulin and total protein are found to be normal. Glucose tolerance curves, however, show late peaks and slow returns to the fasting level, though after giving insulin, mongoloid blood sugars fall normally. This suggests that pituitary failure is not characteristic of mongolism, since the glycotropic hormone effect is unimpaired. Himwich and Fazekas (1940) investigated the cerebral metabolism in mongolism and also in phenylketonuria, using a special method for obtaining blood samples, and they came to the conclusion that less than the normal amount of oxygen and sugar is utilized in both types of case. The writers hold that there is a real diminution in metabolism and not merely a retarded blood-flow. A survey of defectives by Hess (1943) showed that cases of mongolism, together with diplegics, epileptics and hydrocephalics frequently showed arrested descent of the testes—an abnormality closely related to loss of the cremasteric reflexes and due to deep-seated disturbance in the brain and spinal cord.

Cases of phenylketonuria, previously described as occurring in Norway, England, France and the United States, have now been reported from Switzerland (Brugger, 1942) and Canada (Penrose, 1941). Analysis by Munro (1940) of 47 sibships, containing cases of phenylketonuria, of which five showed parental consanguinity, confirmed the recessive origin of the disease. Further information about the nature of the biochemical abnormality involved has been obtained by studying the blood serum and tissues. Kondritzer (1940) studied the precipitation pattern of serum proteins, and found a small but significant increase in the globulin fraction as compared with the normal. Analysis of the amino-acid content of tissue proteins by Jervis, Block, Bolling and Kanze (1940), however, did not demonstrate any differences between normals and phenylketonurics, or "phenylpyruvic oligophrenic individuals," as these writers prefer to term them. Jervis and others (1940) also clearly demonstrated phenylalanine in the blood of such patients, confirming, by a new method, the work of Norwegian investigators. Especially high levels of blood phenylalanine were found after the patients had been fed on high protein diet. Phenylalanine was also found in the cerebrospinal fluid but no phenylpyruvic acid, nor was any phenylpyruvic acid found in the blood, as previously suggested by Jervis. These writers consider that the main abnormality is inability to break down

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phenylalanine. While examining the ratio of creatine to creatinine excreted in the urines of defective patients, Pugh (1940) showed that phenylketonurics had definite creatinuria. High creatine excretion (Penrose and Pugh, 1939) was also found in cases of diplegia and congenital syphilis; it has always been regularly found in muscular dystrophy and hyperthyroidism,. Pugh (1940) further reported that Millon's reaction should be useful as a routine procedure in the detection of cases with defective ability to deal with protein metabolites.

A paper by Bender (1942) on congenital syphilis in relation to mental defect mentions that in congenital cases the blood serology is frequently negative. The diagnosis, which depends upon family history (including a study of sibs) and clinical signs as well as serology, is often difficult. In their text-book on congenital syphilis, Dennie and Pakula (1940) state that the mental retardation caused by the disease is due partly to direct injury by the spirochaete to brain cells, and partly to toxaemic conditions present at a very early developmental stage. Ironside (1940) described an interesting case of juvenile paresis in one of a pair of fraternal twins, whose mother also was syphilitic: mental retardation in the affected twins was present since birth; typical neurological signs developed and no stigmata were present.

IV. Psychology and Training.

The application of mental tests on a wide scale to predict military competence and to screen out defectives has led to the publication, during the war, of a large number of surveys bearing on this topic. There have been also some psychological investigations of independent interest, which should first be mentioned. Cutler, Little and Strauss (1940) studied the effect of benzedrine administration over long and short periods on the test scores of a group of mentally retarded children. Immediately after administration of the drug, improved scores were obtained on the Knox Cube form boards and the Porteous Mazes. No permanent benefit, however, was derived even in patients whose treatments were continued for six months. A somewhat more optimistic view is taken by Moskowitz (1941), who believes that in selected cases benzedrine raises the ability to a point where educational training can be facilitated. Kephart (1939) believes that by specific training programmes the intelligence levels of borderline and high-grade feeble-minded subjects can be raised; his results, which were based on retest data, were striking, but seem to require confirmation. The converse picture, the loss of intelligence due to disease and injury, has received attention from Hebb (1942), who found that lesions tended to produce low scores in both Binet and performance test tasks. Depression of test scores due to temporary dysfunction at an early age gives rise to higher performance test scores than Binet scores because of the learning experience implied in the Binet test. Lesions which develop late tend to produce a condition which approaches adult deterioration, with low performance and relatively high Binet and vocabulary scores. Notwithstanding, Hebb and Penfield (1940) emphasize how remarkably little effect on intelligence level is produced by removal of large quantities of cerebral tissue. In comparing the responses of defectives with brain injury, other types of defective, and normals, Werner and Strauss (1941) noted a special lack of ability to distinguish an

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object from its background on the part of the brain-injured cases. The failure was not due to impairment of sensory function, but was possibly an example of the tendency of these cases to be attracted by irrelevant details. Sirkin and Lyons (1941) studied the incidence of speech abnormality in defectives, and showed that 43 per cent. of high grade cases, 74 per cent. of imbeciles and all idiots had speech defects; much benefit could be derived from the intensive treatment of such defects in the higher grade cases, particularly as an aid to rehabilitation.

An investigation among Army personnel of the relationship between skin diseases and mental capacity was made by Hodgson (1941). Here subnormal intelligence as judged by the Matrix tests was found prevalent in all groups referred for skin conditions, especially infestation (scabies and pediculosis) and venereal disease. Much work has been done on the mental abilities of cases referred by the armed forces on account of psychiatric or behaviour problems, but no great proportion of such cases have usually been found defective. Sutherland (1941) reported that the mean mental age in 45 cases of war neurosis was 12 years on the Matrix tests and 14 years on the Binet. Anderson (1940) pointed out that defectives may sometimes make more satisfactory naval ratings than their more intelligent brethren, provided that no psychopathic features are present. The general principle, however, in most services has been to exclude defectives at the outset, as likely to give unsatisfactory service. The standards have varied in different places, and there is difficulty in making comparisons because of the widespread use of the concepts of mental age and I.Q.; these terms are only correctly applicable to children and, for adults, the use of standard scores is to be preferred. Mecker, Plesset and Grava (1942) state that, although the I.Q. of 60 or over is required to meet U.S. Army induction standards, an I.Q. of 75 judged by the Binet or Kent test should be the lower limit. Esher (1941) considers all cases below 7 years and 11 months mental age, which corresponds to an I.Q. of 50 to 60, untrainable. In a sample of 100 cases specially studied, referred by the British Army, he found that 80 per cent. had relatively high mental ages, i.e. from 9 to 11 years. The drop in intelligence test scores which normally occurs with advancing age is commented upon, and Esher further recommends paying careful attention to school standards. The use of the Kent Test has been widespread because of its convenience and brevity; Rudolf (1941) examined the performances of 367 adult defectives, and showed that male responses differed somewhat from female responses using Earl's adaptation. The Kent emergency test was also first used by Atwell, Bloomberg and Wells (1941) in the U.S. Army, but later replaced by batteries including non-verbal elements. These writers state that the basic question is not one of mental age, still less of intelligence quotient, but is the determination of the subject's capacity with respect to army demands. Myers (1942) believes that intelligence tests for screening purposes should be preferably non-verbal and supplemented by "job analysis." It is evident that although the standards of intelligence required for success in the armed services and success in civilian life are not exactly the same, the experience in the use of tests during the war will have important future bearings upon the concept of mental deficiency in civilian life. It must not be inferred, moreover, that the mentally defective cannot adapt themselves to wartime strains. Benjacar (1940) reports that

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institutional cases co-operate well with A.R.P. work and useful constructional tasks. They show no more liability to panic than normals and are very susceptible to efficient leadership; their reactions to war vary from blissful ignorance to moderately intelligent patriotic interest.

The use of tests for selecting personnel in institutions for defectives is advocated by Buck (1941) and Hadley (1940) to increase the efficiency of the training programme. Some of the results of training delinquent feebleminded children are described by Dwybadd (1941). Many interesting ideas for making institutional life more profitable have been voiced; for example, the teaching of languages to high-grade girls has been found useful (Angilillio, 1942). Discussions on the problems of home training by Nugent (1940) and Horsefield (1942) give outlines of the methods in use which have been found satisfactoryin this field.

In these times, when enthusiasm for all forms of shock treatment for mental cases is high, it was hardly to be expected that defectives would escape attention, and Humphreys, Vassaf, Menzel and Howe (1943) give details of the application of insulin therapy to three morons and two imbeciles on account of behaviour difficulties without, however, being able to report anything more than very slight changes, not always in a favourable direction.

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ENDOCRINOLOGY IN CLINICAL PSYCHIATRY.

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INTRODUCTION.

THE range and precision of clinical endocrinology in recent years have been increased by the introduction of more and better purified hormones, and by the use of hormone analysis and physiological tests for endocrine function.

The importance of the anterior pituitary in many endocrine problems has been demonstrated, and it now appears that some disorders of other glands, such as the gonads, thyroid and adrenals, are secondary to disturbances of the control that it exerts on them through the medium of its special hormones. Among the modern reviews on the physiology and clinical pathology of the pituitary and adrenal glands, subjects outside the scope of this paper, those by Hildebrand and Rynearson (1943) and Kepler and Keating (1941), may be mentioned.

The complexity of endocrine inter-relationships introduces the difficulty of ascertaining to what extent symptoms are primary or secondary to a pituitary disorder, as for example in hyperthyroidism or myxoedema which can be of primary pituitary origin (Lerman and Stebbins, 1942), Cushing's syndrome and amenorrhoea. In psychiatry the difficulty is appreciably greater. Demonstration of undeniable endocrine disturbances does not authorize the claim that they have causal relationship with mental symptoms, and it is seldom possible to assess their relative importance. Nor is it certain in what way psychic events can influence endocrine function although, as in amenorrhoea following emotional upset, or hypopituitarism in anorexia nervosa, it is clear that it frequently does so. There is as yet no clear psychiatric illness due to endocrine causes entirely, or in great degree, and which can be cured by endocrine therapy. Recent work has shown that such conditions may yet be demonstrated, and if so are likely to be complex syndromes.

Most psychiatric hospitals and clinics lack the technical staff and facilities essential for biological assays and other special endocrine methods, so it is not surprising that the majority of papers published in recent years are concerned with treatment. Therapy in psychiatric cases has been mostly dictated by temporal and therefore presumably aetiological connections between physiological and mental events, notably the menopause, climacteric conditions and impotence. A substantial mass of evidence derived from this empirical method exists which shows that, although in some cases endocrine therapy can influence the course of mental events, in many others it is apparently without effect, in spite of the existence of endocrine disorders. There is a real need for objective methods to assess the nature and severity of endocrine factors and of their response to treatment.

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Endocrinological Methods in Psychiatry.

Among the means available for the objective study of endocrine function, i.e. biochemical, physiochemical, histological and hormone analyses, two—estimation of urinary excretion of 17-keto-steroids and the vaginal smear—have recently assumed considerable practical importance.

17-Keto-steroids.

Neutral 17-keto-steroids, the chief of the metabolic end-products of steroid metabolism, can be estimated colorimetrically, and expressed as milligrammes per 24 hours (Callow *et al.*, 1939, 1940). This amount is an index of the secretory activity of the adrenal cortex in females, and of the adrenal cortex and testes in males, and can be correlated with the output of androgens determined by biological assay. Normal ranges per 24 hours are 4·0 to 15·0 mgm. (Friedgood and Whidden, 1939); 3·5 to 14·6 mgm. for females, 9·4 to 20 mgm. for males (Patterson *et al.*, 1942). The daily output for each individual is fairly constant, although variations between individuals are wide, and increases from *nil* at birth to maximum at 18 years, maintained thereafter, with a sharp decline after middle age. Abnormally high values at any age are found in tumours and hyperplasia of the adrenal cortex, interstitial cell tumour of the testis, and sometimes in virilism and ovarian arrhenoblastoma (Talbot and Butler, 1942). Fraser *et al.* (1941) found that the normal range for men between 20 and 40 years was 8·1 to 20·6 mgm., for females 5·1 to 14·2 mgm., and considered that all urinary 17-keto-steroids are derived from the male gonads and adrenal cortex, approximately 5 and 9 mgm. respectively from each. Non-endocrine conditions, such as malnutrition, anaemia, gastro-intestinal disease, infections and especially liver disorders lower the level; they suggest that in uncomplicated cases the following values can be expected: Normal male, 14·0 mgm., female 9·0 mgm., female with Addison's disease 0·0 mgm., male with Addison's disease 5·0 mgm.; pan-hypopituitarism 0·0 mgm.; gonadectomized male 9·0 mgm., gonadectomized female 9·0 mgm.; hypothyroidism very low, sometimes no more than 0·5 mgm. per 24 hours. Thus this estimation has a considerable diagnostic value, and in females may be a definite indication of adrenal insufficiency. Electro-shock therapy and prefrontal leucotomy frequently effect a rise, presumably by interference with the cerebral control of the pituitary, as does injected corticotrophic hormone in hypopituitarism by stimulation of the adrenal cortex (Hemphill *et al.*, 1942; Hemphill and Reiss, 1942); chorionic gonadotrophin therapy stimulates the testis but not the adrenal cortex to increase production of 17-keto-steroids (Fraser *et al.*, 1941).

Vaginal Smear.

Changes in the type of cell and quantity of mucus seen in smears from the vaginal mucosa occur throughout the menstrual cycle and after the menopause (Papanicolaou and Shorr, 1935). Examination of the vaginal smear therefore furnishes important information on ovarian function. A simplified technique has been described by Geist and Salmon (1939), who classify smears from menopausal patients as follows:

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Reaction 1: Advanced oestrogen deficiency—absence of squamous cells, presence of leucocytes and small round or oval "atrophy" cells with darkly-staining nuclei.

Reaction 2: Moderate oestrogen deficiency—varying number of large epithelial cells with fairly large nuclei; a proportion of "atrophy" cells.

Reaction 3: Slight oestrogen deficiency—majority of cells are large epithelial, varying in shape and size, often seen in clumps; few or no "atrophy" cells.

Reaction 4: No oestrogen deficiency—large flat squamous cells with small well-staining nuclei rather smaller than in reaction 3. No atrophy cells, few leucocytes.

Adequate treatment with oestrogens transforms the type of smear according to the changes induced in the vaginal mucosa, and atrophic characters may be entirely removed (Papanicolaou and Shorr, 1936). The appropriate dosage of oestrogens and the duration of therapy can be largely judged on the vaginal smear response. Atypical vaginal smears are not uncommon, and considerable experience is required for their interpretation. These and other complications of the method have been described in detail by Mack (1943).

Endocrine Preparations.

Modern endocrine preparations in use may be considered as anterior pituitary hormones, gonadotrophic hormones, female and male sex hormones, adrenal cortical hormones. Corticotrophic and thyrotrophic hormones, by means of which the pituitary maintains the functional activity of the adrenal cortex and the thyroid and capable of restoring these glands when atrophied, are not available in large quantities. The former has already been used therapeutically in psychiatry, and the latter in hypothyroidism secondary to hypopituitarism. Gonadotrophic hormone is supplied in two forms—from the serum of pregnant mares and from pregnancy urine. The former causes ripening of ovarian follicles and stimulates spermatogenesis; the latter, which chiefly influences corpus luteum formation and the interstitial cells of the testis, has been extensively used in the treatment of male hypogonadism and undescended testis.

Probably none of these preparations are chemically pure and their actions are not simple; there may be several combinations of hormones secreted by the anterior pituitary with gonadotrophic actions, some of which are reproduced by hormones of pregnant mares' serum and pregnancy urine. The usual dose of each is 500 units, repeated two or more times weekly for a number of weeks according to the indications (Simpson, 1942).

Oestrogenic hormones are administered, preferably by injection or implantation, as oestrone, oestradiol, oestradiol benzoate in oily solution, or allied substances, the so-called natural oestrogens, the last named being the most potent, and stilboestrol and hexoestrol, synthetic oestrogens, highly effective by mouth but liable to produce toxic reactions. There is a wide latitude of dosage of natural oestrogens; a few hundred to 50,000 or more units have been advocated as a single dose. From 0·5 mgm. to 5·0 mgm. is about the range of stilboestrol. Hormones of the corpus luteum (progesterone) have not been

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used to any extent in psychiatry. An alternative to progesterone, which is only effective subcutaneously, is pregneninolon, active orally, administered in 20 to 50 mgm. doses (Zondek and Rozin, 1939).

For male sex hormone therapy the choice lies between testosterone propionate by injection, implantation, inunction, or in suppositories, and methyl testosterone orally (sublingually). The dose of the latter, which should be about three times the former, is from 10 to 50 mgm. or more per day (Dodds, 1942).

Extracts of adrenal cortex containing several hormones are used chiefly for substitution therapy in Addison's disease and in shock. One purified hormone, desoxycorticosterone (Doca), can be prepared synthetically. Its action is concerned with the transfer of sodium and potassium ions and regulation of water balance.

The function of the adrenal cortex is disturbed in acute infections and exhaustion, and therefore may play a part in the development of toxic exhaustive psychoses. It has been suggested that neurasthenic-like symptoms after acute infections respond well to adrenal cortical therapy, and may in this way be distinguished from functional neurasthenia (Greene, 1935). Adrenal cortical extracts and Doca are as yet in short supply.

Involutional Melancholia.

Mental changes at or after the menopause are common, and vary greatly in severity. Although predominantly affective reactions of depressive type there is often no history of previous mental illness.

Treatment with follicular hormone has been extensively used on the assumption that cessation of ovarian function with diminished production of oestrogens is causally related to mental change. The results claimed by different groups of workers often appear to be contradictory. These claims could be reconciled to some extent if a common classification of climacteric conditions were adopted, and if mild menopausal illnesses not requiring hospitalization were distinguished from the involution-melancholic psychosis. The latter has been divided into convenient clinical types as simple, paranoid, somatic and mixed according to the symptomatology (Eymon *et al.*, 1942); it is common experience that the prognosis is not equally good in all.

Menopausal symptoms may be both physical and mental, but are troublesome in only about 15 per cent. of normal women, of which a small proportion develop a severe psychosis. Nevertheless male and female involutional melancholia may rank about seventh in importance in mental hospital admissions (Palmer *et al.*, 1941).

The physical symptoms, apart from menstrual irregularities, are, for the most part, vaso-motor: hot flushes in head and trunk, sweats, attacks of aches in head and limbs, paraesthesiae, and neuralgic pains, chiefly in head and back of neck, intermittent breast swellings. Obesity is common, and when associated with low blood pressure is usually accompanied by mental changes (McDowell and Patterson, 1940).

Emotional instability, altered appetite and libido, impairment of concentration, lassitude, depression and vague neurasthenic manifestations are found

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in varying degree, and should be regarded as characteristic of the milder mental reactions. In severe involutional melancholia extreme depression, delusions of guilt and visceral malfunction, paranoid ideas, attempts at suicide, refusal of food, and agitated, resistive behaviour are prominent. Hot flushes and allied symptoms are not infrequently absent. This type of reaction may not be fully developed until a considerable time after the menopause. Detailed accounts of symptomatology are given by McDowell and Patterson (1940), and Hawkinson (1938), based on 1,000 cases.

The vaso-motor and milder neurasthenic symptoms can be observed in premature or atypical menopauses and after hysterectomy, although most markedly where there is a neurotic predisposition, and are to be regarded as largely of endocrine origin (Lewis and Jackson, 1940), but although it has been claimed notably by Ault *et al.* (1941) that involutional melancholia is an exaggeration of the climacteric symptom and curable by oestrogen, it is more generally held that the malignant symptoms depend on many interacting factors, of which the most important and prognostically unfavourable for hormone therapy is the pre-psychotic personality. Typically perfectionistic, penurious, over-conscientious, often lacking in humour and sexual drive, the keynote is " rigidity " (Postle *et al.*, 1941 ; Burlinghame and Patterson, 1941 ; Wittson, 1940). Eymon *et al.* (1942) failed to find any direct connection between the menopause, natural or surgical, and severe involutional melancholia, but noted a rigid pre-psychotic personality as the most important single aetiological factor.

It is believed that production of gonadotrophic and anterior pituitary hormones is balanced by the level of circulating oestrogen, being high when the latter is low ; with irregular ripening of ovarian follicles at menopause the oestrogen level falls and for a time there may be an excessive output of anterior pituitary hormones (Zondek, 1930). Increased urinary gonadotrophins have been observed as early as three days after oöphorectomy (Damm, 1936 ; Salmon *et al.*, 1940). It has been suggested that excessive production of anterior pituitary hormones is responsible for climacteric symptoms, especially vaso-motor disturbances, which do not occur when oestrogen level is low alone, but only if gonadotrophic hormone output is high (Nathanson *et al.*, 1940). Administration of oestrogen can reduce urinary gonadotrophins (Rowlands, Scharpey-Schafer, 1940), and it has been claimed that in this way symptoms are relieved by inhibition of the anterior pituitary, the urinary gonadotrophins' level being a guide to prognosis (Postle *et al.*, 1941 ; Lawrence *et al.*, 1941). Severinghaus (1941), on the other hand, asserts that increased output of gonadotrophins is seldom pathogenic, and that relief may be obtained by oestrogen therapy while it is still high ; Heller (1941) believes that there is no constant pattern for normal excretion of gonadotrophic hormones, assays having no clinical value except in extreme hypogonadism.

Involutional melancholia has been divided into types according to the prevailing endocrine picture (Hemphill and Reiss, 1940): (1) Pure hypo-ovarian ; menopausal symptoms prominent, usually considerable increase of fat. (2) Hypo-ovarian combined with hypo-thyroidism ; menopausal symptoms slight, degree of myxoedema, mental state usually severe agitated

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depression. (3) Hypo-ovarian combined with hyperthyroidism; mental and physical symptoms resemble type 1 with, in addition, obvious hyperthyroidism and some degree of anxiety. (4) Hypo-ovarian combined with hypo-adrenalism; marked loss of weight, asthenia, dry pigmented skin, loss of hair, delusions relating to alimentary disorders, anorexia, refusal of food and deep depression.

They believe that types 1 and 3, which are the more common milder climacteric changes, are related to over-activity of the anterior pituitary; in these types oestrogen therapy is indicated. On the other hand, types 2 and 4 seem to be related to hypo-function of thyroids, adrenals and gonads, secondary to pituitary insufficiency, and in these oestrogen therapy is more likely to be harmful. Types 2 and 4 are more commonly seen in the severe involutional melancholic psychosis, for which convulsive therapy is widely advocated.

Hormone Therapy.

For oestrogen therapy, natural oestrogens in the form of oestrone, oestradiol benzoate or similar products, orally, but more effectively by injection, are widely used.

The synthetic oestrogens stilboestrol and hexoestrol have the advantage of cheapness and greater potency when taken by mouth, but can produce toxic effects. Male sex hormones, testosterone propionate and methyl testosterone for oral and sublingual use have had some vogue. To obtain an equivalent effect, judged on the vaginal smear, after 11 days' treatment with oestrone 1 mgm. daily, alpha-oestradiol benzoate 0·42 mgm., diethyl-stilboestrol 0·5 mgm. respectively are required, somewhat contrary to the results of animal experiments (Stoddard and Metzger, 1942).

In general, menopausal patients excrete little oestrogen and excessive gonadotrophins. The vaginal smear is atrophic, mucus from cervical glands is scanty, viscid and cellular. After adequate treatment with oestrogen gonadotrophins are reduced, the vaginal mucosa is restored, and the cervical secretion becomes clear and acellular. Vaso-motor symptoms believed to be due to unopposed over-activity of the anterior pituitary usually disappear (Bennett, 1942). Dosage and duration of treatment should aim at accomplishing and maintaining these results.

It is claimed by some that with more prolonged and heavy therapy graver mental symptoms can be influenced, but this is much in dispute, and unsupported by physiological evidence.

The physiological action of oestrogen is probably complex; it may in part operate locally upon blood vessels. Reynolds *et al.* (1941) have shown experimentally that arteriole dilatation causes hot flushes; oestrogen prevents this effect by stabilizing the peripheral vascular tree, but may fail if psychogenic influences are outstanding. Although they found that oestrogen did fail in 10 out of 13 cases of induced menopause in the presence of strong psychic factors, they believe that flushing of the menopausal type cannot be produced by a neurosis alone if the ovaries are functioning normally. Oestrogen increases the blood content of the brain in experimental animals (Reiss and Golla, 1940); intense cerebral vascular dilatation may be the mechanism whereby it affects emotional and mental processes (Baruk and Racine, 1940).

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Individual requirements to produce a physiological result vary greatly: 10,000 to 20,000 units intra-muscularly every other day with a smaller maintenance dose thereafter (Ault *et al.*, 1941). 10,000 to 30,000 units every third day with 1,000 to 6,000 by mouth on intervening days until the vaginal smear is normal, with maintenance therapy for a further six months to one year (Hawkinson, 1938) have been found satisfactory.

Implantation of oestrone crystals to ensure a steady absorption of hormone for weeks or months has been advocated (Bennett and Linde, 1942; Salmon *et al.*, 1941; Bennett and Biskind, 1940). There is evidence that fibrous encapsulation sometimes interferes with absorption, and that over-dosage can occur (*vide* testosterone therapy).

Stilboestrol in doses of 1–5 mgm. by mouth is comparable to natural oestrogens in the relief of climacteric symptoms of surgical or natural menopause (Davis, 1940), and can keep the vaginal epithelium at the mid-menstrual form (Severinghaus, 1940), but may not impart the feeling of well-being customary to their use (Salmon *et al.*, 1940). Toxic symptoms, for the most part gastro-intestinal upset, vertigo, pruritus, oedema of the eyelids, fullness in vulva, are not uncommon with the doses of 1 mgm. daily (Rickles, 1941), and have been reported in 10 per cent. (Payne and Muckle, 1940), 64 per cent. (Salmon *et al.*, 1940), and erotic tendencies in a small proportion (Davidoff and Goodstone, 1942) of cases treated with stilboestrol.

A new oestrogenic preparation, oestrone sulphate, a mixture of conjugated oestrogens, has recently been introduced. It is effective by mouth, is less liable to cause toxic reactions than diethylstilboestrol and produces a greater feeling of well-being (Freed *et al.*, 1943). 1·25 mgm. are at least as potent as 2,000 international units of oestrogenic substance and may be more potent than 5,000 units (Sevringhaus and StJohn, 1943).

In order to minimize abnormal uterine bleeding, endometrial hyperplasia, anovulation, and other disadvantages of continuous oestrogen therapy, Palmer (1942) has recommended that diethylstilboestrol should be administered—0·1 to 0·5 mgm. daily by mouth for 21 days with no treatment for a further 5–10 days—in an attempt to simulate a normal cycle, the interval representing the menstrual period. Cyclical oestrogen therapy, although advocated for both, is more suited to younger patients than menopausal subjects where the object is continued relief of symptoms.

Menopausal hyperthyroidism due to over-production of thyrotrophic hormone can sometimes be controlled by oestrogen through the inhibitory effect it exerts on the anterior pituitary, thyroidectomy is ineffective (Goldman *et al.*, 1940).

Prolonged administration of oestrogen is not entirely harmless and can induce functional castration; great increase of eosinophilic cells in the pituitary has been noticed at autopsy after administration of 6,000,000 units in well-divided doses (Zondek, 1940); gross atrophy of adrenal cortex and medulla followed 750,000 units weekly for six months (Dynes, 1939), but there is no conclusive evidence that it has been responsible for uterine neoplasms. Increased sexual drive and pelvic discomfort occasionally aggravate psychic symptoms in mild cases (Heaver, 1940).

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Agitation is a common accompaniment of severe melancholia. On the assumption that it might be due to calcium deficiency, increasing neural activity, Palmer *et al.* (1941) and Strecker (1942) raised the blood-calcium level in a series of selected cases by administration of parathormone 50 to 100 units with ammonium chloride and calcium gluconate. They were unable to report any improvement. Calcium has been credited with augmenting the effect of oestrogen (Kuzrok *et al.*, 1938).

Testosterone has been used as an alternative to oestrogens to relieve climacteric symptoms. It can do so and seemingly inhibit pituitary activity without producing uterine bleeding, either alone or in combination with stilboestrol (Kurzrock and Rothbart, 1942), and with natural oestrogen (Wollner, 1941). The latter reported atypical growths in the cervical mucosa in two cases.

Implantation of testosterone pellets 25 mgm. may be a better alternative to testosterone 5–10 mgm. three times weekly (Silberman *et al.*, 1940). Careful control of dosage must be stressed, for masculinization has followed a six-months' course of testosterone 25 mgm. twice weekly (Hamblen, 1942), and a total amount of 850 mgm. (Greenhill and Freed, 1939).

There seems to be no justifiable indication for androgen in preference to oestrogen therapy in psychiatric disturbances of the female climacteric.

Results of Endocrine Therapy.

Marked improvement or cure in 80–90 per cent. of cases treated has been claimed by Ault *et al.* (1940 and 1941); considerably less optimistic were Hawkinson (1938), Notkin *et al.* (1940), Palmer *et al.* (1941) and others. The results depend on the selection of case material, the response to treatment being obviously very much better in early climacteric neuroses than in severe melancholic states.

The general conclusions that if all menopausal women suffering from various degrees of melancholia were treated with oestrogen the recovery-rate would be better, and the duration of the illnesses shortened than if all were untreated (Danziger *et al.*, 1942), but that only the simple type of illness is likely to be benefited, the severe psychotic picture being seldom altered (Davidoff *et al.*, 1943), are probably true.

Very many papers testify to the excellent results obtained in florid involutional melancholia by convulsive therapy and prefrontal leucotomy, and in such cases these would seem to be the methods of choice.

Hemphill and Reiss (1942) investigated and treated cases of involutional melancholia in which symptoms of hypoadrenalism, i.e. asthenia, " desiccated skin," cutaneous pigmentation, brittle hair, low blood pressure and very low excretion of 17-keto-steroids were combined with anorexia, delusions of alimentary disorder, and severe melancholic depression. They regarded the delusions as derived from adrenal insufficiency, secondary to hypo-pituitarism, with inadequate output of corticotrophic hormone. Treatment with a purified biologically active corticotrophic hormone brought about improvement in appetite and general physical condition with loss of the specific delusions visceral illness. They suggested that these cases belonged to a grou

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involutional melancholics in which hypopituitarism following the menopause is a principal endocrine factor.

Prognosis.

The prognosis of involutional states depends less on endocrine than on constitutional and psychic factors. A strong affective element and absence of paranoid ideas with pliable pre-psychotic personality favour recovery (Burlingham and Patterson, 1941); attempts at suicide may therefore be of good portent (Brussell, 1940). Paranoid ideas, automatism, insufficiency of affect, continued gross somatic delusions, cerebral arterio-sclerosis and duration of illness of more than a year are of grave significance (Strecker, 1942).

In conclusion, in simple menopausal reactions, symptoms of neurotic and neurasthenic nature are combined with the usual climacteric and vaso-motor disturbances varying greatly in severity in individual cases; hyperthyroidism and anxiety may complicate the picture. There is considerable evidence that functional hyperactivity of the anterior pituitary is here of causative importance. Treatment with stilboestrol 0·5–5 mgm. daily by mouth until the vaginal smear is non-atrophic, climacteric symptoms relieved, and urinary excretion of gonadotrophins is low, with a small maintenance dose thereafter, or oestradiol benzoate by injection and later orally, if stilboestrol is badly tolerated, should be successful in the majority of cases. The vaginal smear furnishes the best objective evidence that treatment has been adequate (Ripley *et al.*, 1940); over-dosage is easily achieved and should be avoided, especially in maintenance therapy and prolonged courses of treatment. For the severe melancholic psychosis in which hypothyroidism or hypo-adrenalism are sometimes present, oestrogen therapy is unlikely to be effective, and may by inhibiting pituitary activity be harmful. Convulsive therapy is to be recommended here. There may be a place for corticotrophic and possibly thyrotrophic hormones as an alternative or adjuvant to shock treatment, when they become available in quantity.

MALE CLIMACTERIC.

The incidence of involutional melancholia in males is about one-quarter of that in females, and the onset between 50 and 65 about ten years later (Strecker, 1942). The diagnosis is often unclear, the picture being sometimes complicated by arteriosclerosis and early senility. Important symptoms are: Vaso-motor disturbances, flushes, facial pallor, impotence, loss of sexual interest, prostatic difficulties, headaches, irritability, weakness, fatigability, failing concentration, and in more severe cases agitation, restlessness, insomnia, delusions of guilt and bodily illness, suicidal intentions (Palmer *et al.*, 1941; Werner, 1939), and angina-like pains (McGavock, 1943). A combination of several of these symptoms in a man of over middle age without evidence of dementia should suggest the diagnosis. The symptoms have been attributed to excessive production of gonadotrophic and anterior pituitary hormones and/or defective internal secretion of the testis (Hamilton, 1941). Testosterone propionate by injection, methyl testosterone by mouth and pellets of testosterone by implantation have

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been used to replace testis hormones and to inhibit the anterior pituitary; Catchpole *et al.* (1942) showed that hypogonads excreted excessive urinary gonadotrophins, which fell to normal after three months' treatment with 20 to 70 mgm. of testosterone daily.

Implantation of 300 to 450 mgm. by a special trocar in the posterior axillary line, after an initial course of injections to estimate the requirements and response, has been claimed to maintain a therapeutic effect from 2 to 6 months (Eidelberg and Ornstein, 1941), but there is evidence that pellets become encapsulated and useless by 11 weeks, and that as absorption is irregular the response is not in ratio to the dose, methyl testosterone by mouth being more effective and economical (Escamilla and Lisser, 1941). Androgen therapy has disadvantages. Doses of 5 mgm. can for a while increase, but of 25 mgm. cause reduction in spermatogenesis in normal men (Rubenstein and Kurland, 1939). Rashes, vaso-motor disturbances and headaches and erotism have been recorded (Davidoff and Goodstone, 1942). Minimum therapeutic requirements may be 10 to 25 mgm. two to five times weekly, which have been found sufficient to inhibit spermatogenesis (Pardoll and Belinson, 1941). The reported results of endocrine therapy are not promising; 65 per cent. of one series improved, but this included only mild and moderately severe cases (Davidoff and Goodstone, 1942). Improvement was noted in about half only of another selected series (Dantziger and Blask, 1942). Some improvement in insomnia, headache and motor instability has been recorded (Hill, 1940). Zeifert (1942), employing massive doses, 1,300 mgm. in 40 days, observed no toxic effects, but reported benefit in milder reactions only.

Testosterone may relieve symptoms due to peripheral vascular disease through its local action on blood vessels (Edwards *et al.*, 1939); others have been unable to confirm this (Beaser and Massell, 1942); in the hypogonad it alters pigmentation of the skin, as indicated by the Hardy spectro-photometer (Edwards *et al.*, 1941), and when effective in males usually produces some flushing. It has been shown by endurance tests to produce improvement in dynamic work in eunuchoids (Simonson *et al.*, 1941), but not in normal men (Samuels *et al.*, 1942).

As in female involutional melancholia the most satisfactory form of treatment is convulsive therapy or leucotomy, for in severe cases androgen therapy is probably ineffective. The bulk of the evidence goes to show that testosteron propionate, preferably methyl testosterone orally (suppositories are available), may occasionally produce dramatic results in male climacterics where neurasthenic and vaso-motor symptoms are prominent, and is indicated if urinary gonadotrophins are excessive. It can impart a feeling of well-being by diminishing muscular fatigue and improving circulation if there is a genuine hypogonad element. It may be of benefit in early cerebral arteriosclerosis, and should be given a trial if this condition contra-indicates shock treatment.

Anorexia Nervosa and Hypopituitarism.

Several hypotheses have been advanced to explain the origin of anorexia nervosa, the physical picture of which closely resembles Simmond's disease. Among the more important are: That its cause and development are entirely

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psychogenic; that, following an initial psychic upset, inadequate intake of food and undernutrition produce functional depression of the pituitary and secondary insufficiency of gonads, thyroid, and adrenals; that it is a special or mild form of pituitary cachexia; that it is "cerebral" hypopituitarism, due to alteration of the cerebral control of the pituitary. In spite of the large number of contributions and the considerable interest the subject has aroused, no one hypothesis is entirely satisfactory or generally accepted.

Reviewing 595 case-histories of Simmond's disease and relevant literature, Escamilla and Lisser (1942) give the following as cardinal symptoms: (1) Loss of weight, (2) loss of sexual function, (3) asthenia, (4) low basal metabolic rate (around minus 20). Pregnancy antedated symptoms in 42 per cent. of verified cases, the majority of which were adult females; in some the illness endured for as long as 40 years. Substitution therapy with various endocrine preparations was of value in 60 per cent.

The symptoms of Simmond's disease are due in part to secondary atrophy of gonads, thyroid, and adrenals, from failure of production of anterior pituitary hormones, frequently the result of necrosis of the pituitary following pregnancy. The term Simmond's disease is usually applied to post-partum hypo-pituitarism, but it is generally agreed that a pituitary cachexia can result from pituitary damage due to other causes. Male cases have been described, diagnosed by weight loss, debility, asthenia, loss of hair, skin changes, genital atrophy, hypotension, hypoglycaemic attacks, and reduced excretion of anterior pituitary hormones (Mogensen, 1940; Salomon and Lascano, 1942). Improvement after treatment with chorionic gonadotrophic hormone (Mogensen, 1940), with thyroid extract, testosterone and desoxycorticosterone (Williams and Whittenberger, 1942), with hypophyseal grafts (Marti, 1942; Rochat, 1942), have been recorded. Substitution therapy, however, is seldom of much value in anorexia nervosa (Richardson, 1939).

The clinical picture of a well-developed case of anorexia nervosa corresponds with that of pituitary cachexia in that emaciation is profound, basal metabolic rate usually low, sexual function depressed, but by contrast the subjects are commonly young unmarried women of neurotic obsessional personality, although males have been reported. An important point in the differential diagnosis of anorexia nervosa is that restless hyperactivity is common, as opposed to the weakness and comparative inactivity of Simmond's disease (Brosin, 1941).

Fraser and Smith (1941) have sought to differentiate between organic pan-hypopituitarism and "functional" anorexia nervosa by estimation of 17-keto-steroids and an insulin tolerance test. In the organic disorder they found extremely low or no excretion of 17-keto-steroids, and after injection of insulin under controlled conditions, delay of blood sugar in returning to normal. 17-keto-steroid output was often low in anorexia nervosa, but in no case entirely absent. Although neither test is specific, they believe that the combination of both enables a diagnosis of pan-hypopituitarism to be made with fair accuracy. Their work does not exclude the possibility that so-called functional cases suffered from hypopituitarism, but in less degree than the organic, and it is noteworthy that they do not report conclusive cures by psychotherapy alone.

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A low output of 17-keto-steroids in women indicates adrenocortical insufficiency, which in its turn may be secondary to inability of the pituitary to produce adequate corticotrophic hormone. Weakness, skin and hair changes, hypotension and alimentary disturbances are included in the symptomatology of adrenal failure. Hemphill and Reiss (1942) have described cases of melancholia of both sexes in which these symptoms existed. Some of the females were unmarried; a proportion of the others had had previous pregnancies. In typical examples excretion of anterior pituitary hormones was *nil* and of 17-keto-steroids very low. Injected corticotrophic hormone caused improvement in appetite, nutrition and mental state; 17-keto-steroid output rose to normal level, attributable to trophic stimulation of the adrenal cortex. It appears that adrenal failure is a main factor in symptom production in hypopituitarism. In anorexia nervosa histo-pathological changes in the pituitary are not found at autopsy (Brosin and Apfelbach, 1941).

On the whole, the pathogenesis of anorexia nervosa suggested by Stephens (1941) seems to be the most acceptable. As a result of some mental disturbance appetite is lost and food intake is reduced. Atrophic and functional insufficiency of pituitary and other endocrines ensues primarily from gross under-nutrition. Depression of adrenals, thyroid and gonads occurs secondary to hypopituitarism, metabolism is affected and the typical physical picture is thus produced. Psychotherapy and adequate feeding may reverse these changes unless extreme; endocrine preparations may be unnecessary, but probably anterior pituitary hormones will assist (Doane *et al.*, 1939; Magendantz and Prager, 1940). Corticotrophic hormone is indicated if 17-keto-steroid output is low; when effective there should be an increase towards normal. It is improbable that deliberate starvation alone, unaccompanied by neuro-psychic irregularity, can produce the picture of typical anorexia nervosa. In hunger-striking prisoners, for example, weakness is often an earlier symptom than emaciation, and prohibits much effort and physical activity. Body cold, seemingly not experienced in anorexia nervosa, is keenly felt and complained of.

It is possible that an abnormal psychic state may, by interfering with the cerebral control of the pituitary, depress its function. One such case has been described (Reiss, 1943). Gross emaciation gave place to pathological obesity. He has proposed the designation "cerebral" pituitary cachexia for anorexia nervosa.

In conclusion the diagnosis of functional anorexia nervosa should not be made if excretion of anterior pituitary hormones and 17-keto-steroids is markedly subnormal. Motor hyperactivity out of proportion to the muscle bulk, apparent strength and the characteristic combination of the age, sex and personality type suggest the diagnosis. Where there is objective evidence of low hormone excretion anterior pituitary hormones should be administered coincidentally with other measures.

Substitution therapy offers the only hope in organic hypopituitarism.

Pregnancy and Puerperium.

Mental disturbances in pregnancy and the puerperium occur in 1 to 2 per cent. of cases; there is no characteristic psychotic reaction (Cruikshank, 1940;

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Wick, 1941; Kraines, 1941; Skottowe, 1942), and no evidence of a specific lactational psychosis. Schizophrenia and manic-depressive illnesses appear to account for about 60 per cent. of the total, but there is considerable disagreement between different authors, toxic-exhaustive reactions being cited at 3·6 per cent. (Smaldon, 1940) and 38 per cent. (Cruikshank, 1940). Boyd (1942) gives the following distribution: Manic-depressive 40 per cent., schizophrenic 20 per cent., delirium 28·5 per cent., psycho-neurosis 6 per cent., psychopathic personality 5 per cent., other conditions 0·5 per cent. Primiparae are most commonly affected (Imaz and Dubrowsky, 1939), but in Smaldon's (1940) series of 64 cases of dementia praecox, out of 220 pregnancy reactions multiparae predominated.

There is no case for terminating pregnancy as a prophylaxis, for repeated pregnancies do not necessarily cause subsequent psychotic recurrences (Howarth, 1939), and with the most complete family and personal history attacks cannot be predicted in more than 50 per cent. (Skottowe, 1942). A minority of reactions occur during gestation; the prognosis in ante-partum schizophrenia is very unfavourable (Cruikshank, 1940). Apart from constitutional make-up, severe emotional stress and malnutrition have been, it appears justifiably, cited by Howarth (1939) as important in the aetiology, and it is emphasized that adequate dietary control may prevent recurrences.

Although there is little evidence that any endocrine dysfunction has a specific influence, cases of puerperal schizophrenia have apparently cleared up after treatment with progesterone, possibly by correction of placental loss of luteal hormone which accentuated a psychotic reaction (Blomberg and Billig, 1942; Schmidt, 1943).

Treatment with luteal hormone, therefore, may be worth trying empirically in post-partum psychoses, and may even be indicated where there is a history of persistent premenstrual tension, or frequent anovulatory phases.

Mental Disturbances Related to the Menstrual Cycle.

Fluctuations in mental and emotional stability are observed in a fair proportion of women during the menstrual cycle. The incidence of fits in some epileptics bears a constant relationship to menstruation. Disturbances of water metabolism through the action of steroid hormones or hormonal imbalance may be of importance. Oedema seen in the premenstrual phase has been shown to be due to the water-retaining properties of steroid hormones (Thorn *et al.*, 1938). Relief of premenstrual discomfort may be obtained by administration of ammonium chloride in large doses, with the object of discharging sodium retention and thereby securing increased output of water (Greenhill and Freed, 1940), and may rationally have an application in the treatment of epilepsy, associated with water retention. Progesterone to replace insufficient production of corpus luteum hormone, a usual hormonal disbalance of anovulatory menstrual phases, has been advocated for the treatment of mental swings in the menstrual cycle (Israel, 1938; Schmidt, 1943). A more effective way of securing the same result is by injection of gonadotrophic hormone of pregnant mares' serum in the early part of the menstrual cycle to stimulate follicular ripening, ovulation and therefore formation of luteal hormone.

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Schizophrenia.

In no psychosis or group of psychoses can endocrine abnormalities be demonstrated as readily and with such a diversity of form as in schizophrenia. Nevertheless, apart from certain thyroid relationships, which have an importance with special forms of schizophrenia, no endocrine disorders have yet been described which consistently form part of the symptom picture of any schizophrenic reaction, and whose treatment has produced mental cure.

It has long been recognized that in schizophrenia the response to thyroid feeding is variable and sometimes unexpected, and occasionally mental improvement does take place (Hoskins and Sleeper, 1929; Angyal *et al.*, 1940). Cohen and Fierman (1938) found that in some schizophrenics daily administration of 15 to 18 gr. thyroid extract did not produce toxic or psychic effects, and that in spite of a great increase in oxygen consumption the pulse-rate fell after reaching a maximum of 110. It is not known why these anomalies are found nor what constitutes the form of schizophrenia in which they occur, but one clinical entity has been investigated in which fluctuations in mental state can be correlated with metabolic disturbances, susceptible to the influence of thyroid hormone.

Periodic Catatonia with Periodic Disturbances of Somatic Function.

Under this heading Gjessing (1938, 1939) described a small group of schizophrenics, perhaps not more than 3 per cent. of all cases, in whom catatonic phases coincided with abnormal retention or excretion of nitrogen. He demonstrated that if the nitrogen retention was depleted by administration of thyroid hormone, in the positive storage type, the patient emerged from catatonia and could be kept well thereafter by a maintenance dose. Complete estimations of nitrogen balance are beyond the resources of most mental hospitals, but thyroid extract should be tried empirically in periodic or recurring catatonia. Hardwick and Stokes (1941) investigated nitrogen metabolism in cases believed to belong to Gjessing's group, and others as controls. They give the following criteria by which patients suitable for thyroid treatment may be recognized without preliminary biochemical studies: (1) Rhythmic illness of periodic catatonic type; (2) phases of illness always associated with increase of temperature, pulse and basal metabolic rate; (3) good tolerance of thyroid; (4) gain of weight during treatment.

Hyperthyrotic Catatonia.

A small group of female schizophrenics in which thyrotoxicosis was associated with catatonic phases, sometimes amounting to stupor, visual hallucinations, and disturbance of the body image, has been described by Hemphill (1942). Spontaneous recovery occurred in all cases; in some there had been previous attacks and remissions. There was no evidence of thyrotoxicosis, nor of goitre, associated with schizophrenia of any other form in a large series of mental patients. Relevant literature shows that schizophrenic reactions are by far the rarest mental complications of hyper-thyroidism, and tends to confirm the suggestion that when they occur, they have this special form in

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which the ultimate result is remission irrespective of the severity of the psychotic symptoms. The extreme rarity of goitre, in spite of the similarity in age-incidence, is a further illustration of endocrine hypoplasia in schizophrenia of early life.

Gonadal Function in Schizophrenia.

Testicular biopsy has been used by Hemphill *et al.* (1943) to demonstrate atrophic and degenerative changes in the testis in schizophrenia. The histological appearances were similar to those described by Mott (1919), and were not in proportion to the age, physical state of the patient, or to the duration of the psychosis. The testis appeared to be damaged most severely where symptoms had developed soon after puberty and in the rapidly dementing and deteriorated chronics, least where the onset dated to the late twenties and in the paranoid and mild chronic types. The pathological picture of severe testicular damage resembled in certain respects the secondary atrophy produced by hypophysectomy in animals. The analogy suggests an original pituitary disorder in schizophrenia antedating the histological and presumably mental pathology, and may provide a basis for treatment with anterior pituitary hormones.

Attempts to correct apparent gonadal disorder in schizophrenia with testosterone have been made by Helman (1939), Hoskins and Sutherland (1942), and with desoxycorticosterone by Haynes and Carhill (1941), who claim to have produced improvement but no definite cure. On the case-material and results it cannot be fairly asserted that these preparations in the dosage employed have any therapeutic value in schizophrenia.

Rosenweig and Frieman (1942) administered thyroid extract, testosterone and anterior pituitary gonadotrophin simultaneously to selected cases. They have reported that their patients responded by showing an increase of sexual interest, as measured by an instrument of their own devising, the "photoscope." Their work goes no further than to show that some psychological alteration, and possibly increase of psychic libido, can be stimulated in certain examples of schizophrenia by administration of hormones. It cannot be construed to indicate that hypogonadism is a common clinical symptom requiring specific treatment. Inadequate secondary sexual characteristics and homosexual tendencies were treated with testosterone in seven young cases of schizophrenia (Barahall, 1940). There was improvement in the somatic symptoms and increased growth of hair; mental state was unaffected.

Among other reports of endocrine irregularities, hypercreatinuria in 14 out of 20 cases, some without regression of secondary sexual characteristics (Stora and Tchernikowsky, 1938), and failure to respond in a normal way to injected pitressin by intestinal cramp and raised blood pressure (Finkelman and Simon, 1939) have been recorded.

Chemical studies of the level of adreno-cortical substances in blood during hypoglycaemic and shock treatment of schizophrenia were made by Tietz and Birnbaum (1942). They found, in 29 cases, that recovery was accompanied by a rising adreno-cortical substance level, after coma and electro-convulsive therapy. Failures showed low values and a great susceptibility to shock.

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In conclusion, there is a large body of scattered evidence indicating endocrine disturbances in schizophrenia, sufficient to prompt the suggestion of Hoskins (1943) that an abnormal sensitivity to sex hormones may be a major causative factor. But it is as yet too indefinite and incomplete to be a guide to therapy. This in the present state of knowledge should serve to discourage the indiscriminate use of potent hormone preparations.

Thyroid extract is worth a trial in cases of recurring or periodic schizophrenia that conform to the criteria given above. Spontaneous recovery is probable in schizophrenic reactions associated with thyrotoxicosis.

Mental States Associated with Disorders of the Thyroid.

(1) *Thyrotoxicosis.*—Mental reactions are uncommon in toxic goitre. Newton (1938) reported 4, confusion or depression, in 450 consecutive cases ; 3 survived operation ; their mental symptoms were not relieved. Howard and Ziegler (1942) investigated 70 thyroidectomized patients from the psychiatric angle. Prevailing disorders were depression, elation, or psychoneuroses ; delirium was infrequent and slight ; schizophrenia was not seen. They found no evidence that emotional states could cause hyperthyroidism. In the differential diagnosis between anxiety and hyperthyroidism, Beck (1939) maintains that apart from severe bodily illness in the latter there is no single symptom or combination of symptoms that have not been observed in both. The history alone furnishes a clue. It has been claimed that measurement of the impedance angle, an electrical property of the body, which has been used to assess degrees of hyperthyroidism (Brazier, 1933), could provide this distinction, but the value of this test has been seriously questioned on theoretical and clinical grounds by various workers. Hyperthyroidism is sometimes a complication of the menopause. It is then usually associated with depression and should be treated with oestrogens ; operation is ineffective (Wohl and Pastor, 1941).

Myxoedema.—Psychotic reactions in myxoedema are rare. Crowley (1940) observed 2 out of 4,500 mental admissions in 14 years. In both there was a paranoid state occurring after the menopause, probably a form of involutional melancholia, with special somatic delusions that the face was changed and visceral functions altered. Treated with thyroid extract both recovered. Wolfson (1940) has described two cases of myxoedema with restless confusion in the seventh decade which improved with thyroid treatment.

Therefore, apart from the references made in the section on schizophrenia, recent work has shown no specific relations between disorders of the thyroid and mental illness, and it appears that mental reactions are probably incidental. Thyroidectomy can in no case be advocated for the relief of mental symptoms.

Psychoses in Hypo-parathyroidism.

There is no psychosis characteristic of hypo-parathyroidism, but psychotic symptoms in 5 out of 18 cases of this uncommon condition have been described (Green and Swanson, 1941). Anxiety and a sense of impending disaster were common general symptoms, usually followed by toxic delirium during the first four months ; delusions of persecution, sexual hallucinations, and attempts at

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suicide were also observed. The prognosis is good. After adequate treatment for tetany the mental symptoms cleared up.

Deficiency Diseases.

Some evidence that anterior pituitary activity influences utilization of the vitamin B group has been provided by Sutton (1942). Great improvement was reported after treatment with anterior pituitary extract in severe pellagra, which had failed to respond adequately to vitamin B complex. Equivalent results were obtained with gonadotrophic hormone, and its use is recommended in alcoholic polyneuritis as well as pellagra. A further paper by Ashworth and Sutton (1942) provides supporting evidence. Administration of oestrogens in their cases of subclinical vitamin B complex deficiency produced polyneuritis, pellagra and cheilosis; the early symptoms were tenderness and pain in the nasal mucosa. They suggest that this deficiency is due to additional strain on the liver, but as it is now accepted that oestrogens can inhibit the anterior pituitary, it is more likely that disturbance of the anterior pituitary-vitamin B relationship is more important. There is much evidence from experimentally produced vitamin deficiencies in animals that spermatogenesis can be revived by administration either of additional vitamins or alternatively of a gonadotrophic hormone. Whether a disturbance of the pituitary is responsible for failure to utilize vitamin B, or is itself secondary to this vitamin lack in humans, is not known, but it is clearly of value to treat intractable polyneuritis and pellagra with gonadotrophic hormone or potent anterior pituitary extracts as well as vitamin B complex, and to ensure complete vitamin requirements during oestrogen therapy. This is of special importance in melancholic patients who are under-nourished and refuse food.

Confusional Insanity.

The value of cortical suprarenal extract in certain types of acute confusion has been reported by Hoff and Straby (1940). Five cases of confusion in typhoid fever and four due to post-partum haemorrhage treated with suprarenal extract (cortigen, 2 c.c. intravenously daily) cleared up quickly. No response was obtained in other types of confusion. Indications for this treatment are low blood pressure, asthenia and pale yellow complexion. It is probable that where there has been severe loss of fluid and alteration of the sodium-potassium balance, suprarenal cortical extract by its specific action on electrolytes and body fluid has therapeutic value.

Epilepsy.

Although there is so far no direct evidence of an endocrine origin for epilepsy, disturbances of water balance can produce seizures in predisposed individuals. This fact has been used to differentiate between idiopathic epilepsy and hysterical fits. The test aims at inhibiting diuresis and increasing body hydration, by administration of pitressin and large quantities of water. A modified technique has been described by Blyth (1943) as follows: The bowels and bladder cleared, the patient is weighed and confined to bed. Sedatives are

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discontinued, ordinary diet maintained, and a copious intake of fluids ordered. The amount ingested and urinary output are measured and charted daily and the patient weighed morning and evening. An increase of 2 per cent. in body weight, with ingestion showing an increase over excretion, is evidence that a positive water balance has been established. This is attained on the average in 48 hours. ·25 c.c. of pitressin intramuscularly and 300 c.c. of water orally are then administered, followed thereafter by ·5 c.c. of pitressin and 300 c.c. of water every two hours up to ten doses, unless a fit results before. In susceptible cases fits usually occur by the fifth or sixth injection. Blyth claims that an accurate diagnosis was obtained in 87 unselected cases of average adult age. Fits were not produced in hysterical and non-epileptic subjects. Contra-indications to the use of pitressin are diabetes, nephritis, hypertension and cardio-vascular degeneration. Although this test will not necessarily demonstrate the existence of epilepsy in every epileptic subject, a positive result excludes certain non-epileptic conditions, e.g. hysteria, in epileptic suspects after as short a period as 72 hours' observation and hospitalization. The usually disagreeable nature of the test and limited information it affords should restrict its application to where a potential economy in time is of paramount importance.

Manic-Depressive Psychoses.

Apart from observations on affective reactions occurring after the menopause, a proportion of which are of the manic-depressive group, very little has been published about the endocrinology of this subject. Cahane and Cahane (1939) described hyperpituitarism in 50 per cent. of a series of manic-depressive psychotics (some in each phase). They base their statement on hypertrophy of the thyroid, excess of thyrotropin, and positive melanophore reaction in urine. Apparently their work has not been followed up, nor provided any basis for endocrine therapy in the manic-depressive psychosis.

Abnormal Sexuality.

Homosexuality.

Allen *et al.* (1938) have discussed at length endocrine and psychological causes of homosexuality. They have produced evidence that both may provide a basis for the aberration, and have reported cases where more heterosexual behaviour was noticed after unilateral adrenalectomy. Their investigations do not exclude homosexuality occurring in a normal endocrine constitution.

Histological studies of testes from what was described as a pathologically bi-sexual individual, failed to provide evidence of a pathological condition responsible for the psychic abnormality (Bogliolo, 1937).

In an attempt to find endocrinological co-relationships, estimations of androgens and oestrogens were made in 200 physically normal subjects; in 25 out of the 29 included clinical homosexuals androgen output was significantly less than oestrogen (Neustadt and Meyerson, 1941). On the results of hormone analyses in 17 male homosexuals and 31 controls Wright (1941) concluded that when the androgen-oestrogen ration is less than ten, homosexuality is to be

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expected. His paper gives few clinical details, but his conclusions agree with those of Glass *et al.* (1940). There is therefore striking evidence that an endocrine abnormality exists in some forms of homosexuality, and investigation in this field offers prospects for further study. There is no known endocrine treatment.

Hyper-sexuality.

Precocious boys and male sexual criminals were treated with stilboestrol, 5 mgm. daily, for 75 to 135 days (Dunn, 1941). Hyper-sexual tendencies were reduced and there was an accompanying pathological degeneration of seminiferous tubules. On cessation of treatment the tubules regenerated to some extent and abnormal behaviour was again evident within two months.

Castration has been advocated in unstable mental defectives and potential sex criminals (Hawke, 1941). He has claimed emotional and character stabilization and general mental improvement in 80 per cent. of 229 so treated. Vasectomy was not satisfactory. There was no change in voice or weight when castration was performed after puberty.

Cases subjected to legal castration for habitual or criminal sex offences have been examined by Rossle (1935), Koopman (1936), Sand and Okkels (1936, 1937). In the majority improved conduct resulted, but histological investigations of the removed testes seldom showed any signs of hyperactivity, atrophy was more commonly observed. On the whole there was little significant difference between testes of sex criminals and controls of comparable age and health. Koopman (1936) considered that if the testes had been available for histological examination before castration (as by biopsy) the operation could not have been justified in a single case. The social benefit of the operation must not be ascribed to the immediate endocrine effect, nor can it be held that hypersexuality is the result of abnormal or hyperactive testicular function.

Five cases of nymphomania were treated with 25 mgm. of testosterone at intervals with the object of inhibiting gonadal activity (Rubenstein *et al.*, 1940). Sustained cure was noticed in all. The authors warn that small doses of 5 mgm. may excite libido—an effect noted by Greenblatt *et al.* (1941); large doses are essential. Reports from other sources suggest that in frigid or physically normal women androgen therapy even in reasonably large doses may provoke rather than inhibit erotic tendencies.

Hypo-sexuality.

It is of importance that hypo-gonadism and cryptorchidism in young psychiatric cases should be treated. In the latter gonadotrophic hormone is usually employed and treatment preferably started before puberty. Among the many papers which might be cited, that of Thompson and Heckel (1941) is representative. They employed chorionic gonadotrophic hormone, 100 to 500 units three to six times per week. Testosterone orally, 10 to 40 mgm. daily, has been used in hypogonadism. Improvement in genital growth, increase of weight and libido, with improved sense of general health, have been commonly reported (Pratt, 1942). Tager (1942) claims that treatment has little effect in maturity; Eidelsberg and Ornstein (1940) point out that in true hypo-

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gonads treatment must be continued, the patient being unable to do without maintenance therapy. They have noticed no ill effects in such cases, even after a course of as much as 2,700 mgm. of testosterone propionate, and advocate implantation of 200 mgm. to cover a period of eight to sixteen weeks. Testosterone propionate is of low activity when administered orally. Methyl testosterone, sub-lingually, has about one-quarter of the potency of injected testosterone; it is therefore suitable for maintenance therapy (Spence, 1942). It seems probable that reduction in fatigability characteristic of the eunuchoid and improvement in libido and genital growth are reflected by loss of neurotic feelings and of the sense of being a social misfit.

That retarded growth and hypogonadism are important factors in youthful behaviour problems has been stressed by Rubenstein (1942), who treated a series of hypogonad boys with testosterone, 25 mgm. two to three times weekly. He believed that the improvement in growth and sexual development which resulted rendered the subjects more open to suggestion and psycho-therapy, and reported that all became much more socialized. He points out that it is thus possible to counteract a dysplastic tendency by endocrine therapy.

Impotence.

The literature on this subject allows two conclusions to be drawn: (1) That castrates are not necessarily impotent, and that (2) impotence is not primarily an endocrine problem. The effects of castration have been dealt with by Tauber (1940) in an extensive review. Lange (1934) found that of 220 men castrated by war wounds 165 had married subsequently, and that good sexual drive was still present in the majority. Miller *et al.* (1938) described four surgical castrates, and two " psychic " impotents, as " broken in spirit "; hot flushes, irritability, uncontrollable moods, fatigability were present in the organic cases. Only the latter responded well to testosterone, 20 mgm. thrice weekly, lost the special symptoms and regained erectile capacity. Pulten *et al.* (1942) have stressed the importance of the psychic element in androgenic failure; there is no relationship between potency alone and androgen output (Wolbard, 1941).

Spence (1940) found that testosterone, 50 to 100 mgm. thrice weekly, sufficient to cause prolonged erection in eunuchs, was without effect in six cases of functional impotence.

Impotence is to be regarded as a psycho-therapeutic problem. Testosterone is of value only where there is definite objective evidence of hypogonadism; if there is only a slight neurotic element its stimulation may help, but it may, by increasing anxiety, aggravate the neurosis. Genito-urinary abnormalities are less important than psychic and emotional events; injected inert oil has frequently been found as effective as testosterone (Carmichael *et al.*, 1941). Testosterone is sometimes helpful in impotence of the male climacteric (Reed and McMillen, 1941).

Neurotics as well as hypogonads have a tendency to become dependent on testosterone, and once instituted it may not be easily dispensed with. This possibility is worth considering in each case before embarking on androgen therapy.

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Adreno-genital Syndrome.

Allen *et al.* (1938 and 1939) and Broster (1942) have described as a clinical syndrome in young women after puberty the association of an irregular growth of hair of male distribution, increased output of androgens, and frequently mental changes. The usual mental symptoms have been of paranoid type, with jealousy, shyness, ideas of reference and auditory hallucinations. The intensity of the mental reaction is no doubt, at least in part, due to the sense of inferiority and oddness induced by the cosmetic and social handicaps. The syndrome is attributed to pathological hyper-activity of the adrenal cortex. In some cases adrenal tumours have been found; in others hyperplasia of the cortex of the removed gland has been demonstrated histologically by a positive ponceau fuchsin reaction. Loss of hirsutism, reduction in excretion of androgens and in some cases disappearance of psychotic symptoms have followed unilateral adrenalectomy.

The condition may be suspected and operation contemplated in young female mental patients showing increasing virilism and an abnormally raised androgen output. Operation is valueless in menopausal hirsutism (Broster, 1942).

Cushing's Syndrome.

This disease, usually due to a basophil adenoma of the anterior pituitary, has as characteristic symptoms truncal obesity, moon face, purple linea atrophica and osteoporosis. Mental disorders occur with some frequency, and are usually depressions of reactive type, with agitation and sometimes ideas of jealousy in the later stages (Maclay and Stokes, 1938; Schlesinger and Horwitz, 1940; Lintz, 1941). Additional symptoms are lumbo-sacral pain, headache, dizziness, muscular weakness, polyuria, abdominal pains, loose motions, tendency to hypertension, hyperglycaemia and poor sugar tolerance, insomnia, restlessness, hirsutism and male pubic hair (Lintz and Tiner, 1941), sexual dystrophy, polyphagia, polydipsia, ecchymoses (Maclay and Stokes, 1938), relatively low output of urinary androgens (Broster, 1940).

The combination of a depressive illness with some of these symptoms, especially those first mentioned, should suggest Cushing's syndrome. The diagnosis from the adrenogenital syndrome may not be easy. A very high output of androgens points to the latter; pathological obesity is more suggestive of the former (Broster, 1940). Irradiation of the pituitary has been found effective (Lintz, 1941).

Calvarial Hyperostosis.

Localized hyperostoses of the inner table of skull are not uncommonly found at autopsy or by skiagram. Morgagni (1765) observed that this condition was sometimes associated with obesity and virilism, but his observation remained neglected until recent years. Following the accounts of Stewart (1928) and Morel (1931), hyperostosis frontalis interna has been regarded, but not universally recognized, as a distinct disease sometimes called "Morgagni's syndrome." Moore (1935) found radiological evidence of cranial hyperostosis in 72 out of 6,000 non-mental cases, and in 14 out of 33 psychotic females.

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Eldridge *et al.* (1940), in their study of 50 undoubted examples from a series of 200 psychotics, drew attention to the great preponderance of mental patients with cranial hyperostosis. They were unable to agree that Morel's triad of symptoms, i.e. obesity, visual defect and neurological disorder, was typical, and could find no case that conformed exactly with Morel's syndrome. Hyperostosis was present before the 40th year in 26 cases; obesity was prominent in 8 only; there was no endocrine condition common to many. They regarded calvarial hyperostosis as due to a general metabolic disorder seen in various mental illnesses, probably about 20 times as frequently as in the non-mental population.

Included in the extensive review of Roth (1942) are 8 personally investigated cases, all females. The extremes of age were 26 to 72. There was no characteristic mental illness; the youngest suffered from reactive depression. Facial hirsutism and truncal obesity were common, and in a few, abnormal sugar tolerance and other signs suggestive of pituitary involvement were seen. Cerebral arteriosclerosis and hypertension complicated some of the older cases. Such neuro-psychiatric signs as existed could not be attributed to the hyperostosis.

Relevant theories as to causation are discussed by Williams (1941); no satisfactory conclusion is advanced. He describes the commoner radiological forms of hyperostosis as frontal, nebular, diffuse, fronto-parietal; the terms are self-explanatory. In all his cases the coronal suture was effaced. This may be an early radiological sign. The extremes of age of his 19 cases were 41 and 79 years respectively; the period of hospitalization varied between 2 months and 48 years. Maximum heights and weights were respectively 66 in. and 59 in., and 285 lb. and 167 lb. The types of mental illness represented were: Dementia praecox 8, paranoid states 4, mental deficiency 4, cerebral arteriosclerosis, manic-depressive psychosis, cerebral syphilis one each.

Among female cases described by Hemphill and Stengel (1940) were three members of a family in which calvarial hyperostosis and a paranoid psychosis seemed to be inherited. Advanced bony changes were present in the skull of the youngest, aged 10, at a time when no endocrine nor neuropsychiatric could be detected. Meningeal irritability attributed to pathological changes in the meninges was observed in two, one not of the family. Blood calcium was within normal limits. No aetiological causes were ascertained.

At autopsy on the eldest, aged 65, there were degenerative changes in the frontal and parietal cortex and nuclei supraoptici. A small eosinophil adenoma of the pituitary, adrenal cortical hyperplasia, and evidence of parathyroid hyperfunction were found. Sclerosis of the anterior pituitary had been described previously (Stewart, 1928).

In conclusion, hyperostosis frontalis interna is found in a wide range of mental illnesses, almost exclusively in females, upwards of twenty times as frequently as in the non-mental population. Although in the majority of cases it is discovered accidentally and does not give rise to symptoms, in a few there are neuro-psychiatric and endocrine abnormalities sufficient to justify the recognition of a syndrome. Pathological studies in some cases have pointed to a complex endocrine disorder involving the anterior pituitary, suggesting

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an earlier hyperactivity. Although the arteriographic investigations of Moniz (1938) have indicated an increase of intracranial pressure in some patients, no operative or other form of treatment has been found of value. The belief that this condition is one of adult or old age is obviously unfounded, as there is nothing to show, in the great majority of cases, how long intracranial hyperostosis had existed before detection, and juvenile examples do occur.

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CONVULSION THERAPY.

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Therapeutic convulsions were introduced by Meduna (1937) in 1934. After preliminary trial with intramuscular camphorated oil, Meduna soon discovered the great advantages of intravenous cardiazol (leptazol, metrazol), which remains the best of the chemical methods of fit production. Many descriptions of the various aspects of the cardiazol fit are available (Cook, 1938*a*; Ebaugh and Shanahan, 1939; Katzenelbogen *et al.*, 1939; Strauss, Landis and Hunt, 1939; Dean, 1940; Hemphill, 1940).

Triazol (azoman, hexazol) (Walk and Mayer-Gross, 1938; Braunmühl, 1938; Wyllie, 1940), ammonium chloride (Bertolani, 1938; Dax, 1940) and picrotoxin (Low *et al.*, 1939, 1940) have also been used. Triazol can be used intramuscularly as well as intravenously, but its action is less dependable and regular than cardiazol, and it appears to be far more dangerous. Wyllie (1940) reported 4 deaths in 85 cases treated by triazol, and Nightingale and Meyer (1940) 1 death in 59 cases.

The chief drawback to most forms of chemical induction, and particularly to cardiazol, is a feeling of horror and apprehension, often quite indescribable, experienced by the patient during the few seconds between injection and unconsciousness. This causes a real dread of the treatment in many cases. Thrombosis of veins at the site of injection is another disadvantage, which sometimes prevents completion of the course, especially in plump females with small superficial veins. Thrombi formed in the injected veins may lead to pulmonary or other infarcts (Zeifert, 1939).

In 1938 Cerletti and Bini, after ensuring its safety by comprehensive animal experiments, described an electric method of administering convulsions. There are many excellent descriptions of the technique (Cerletti and Bini, 1938; Fleming *et al.*, 1939; Golla *et al.*, 1940; Shepley and McGregor, 1939, 1940; Kalinowsky and Barrera, 1940; Gonda, 1941; Androp, 1941; Hemphill and Walter, 1941; Whitsell, 1942). The electric convulsion differs from the cardiazol convulsion in that there is (1) immediate unconsciousness on applying the current, (2) absent or short latent period between unconsciousness and fit (Gonda, 1941; Goldman and Baber, 1942), and (3) reduction in time and severity of tonic and clonic phases (Shepley and McGregor, 1939, 1940; Golla *et al.*, 1940; Gonda, 1941). The total duration of the electric fit averages 35 to 50 seconds as against 35 to 75 seconds with cardiazol.

Its main advantages are (1) less unpleasant (Barnhoorn, 1940; Smith *et al.*, 1942; Shelton, 1942); (2) reduction of complications owing to milder convulsions—fractures are reduced from 22 per cent. to 5 per cent. (Smith *et*

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al., 1942); (3) absence of venous fibrosis and thrombus formation; (4) simpler and quicker administration (Fleming *et al.*, 1939; Barnhoorn, 1940; Smith *et al.*, 1942); (5) economy (Fleming *et al.*, 1939; Smith *et al.*, 1942).

The freedom from severe apprehension, due to instantaneous unconsciousness and slight retrograde amnesia, and the reduction in vertebral and possibly other fractures are alone sufficient to make ECT the method of choice. As far as I can ascertain no deaths have occurred due to the electric shock itself. There would appear to be no significant difference in the results of treatment by cardiazol or other injection methods or by electric convulsions (Whitsell, 1942; Pacella and Barrera, 1943). "The method is technically effective, simple and safe, and arouses no fear or hostility in the patients" (Fleming *et al.*, 1939) is a very fair summary which has been amply confirmed.

Course.—The success of convulsion treatment depends to no small extent upon the adequate nature of the course. The usual spacing is three convulsions a week (Beckenstein, 1939; Zeifert, 1941; Kalinowsky and Worthing, 1943). Shelton (1942) prefers 5-day intervals to avoid temporary confusion and amnesia, but Hemphill and Walter (1941) consider three times weekly is not always enough and advocate daily convulsions in some cases, at least during the first week. Kalinowsky and Worthing (1943) obtained no better results with daily than with thrice-weekly treatments. There is no doubt that the effects of treatment are apt to wear off between fits if the interval is too long, and every other day appears to be the most favourable routine spacing.

The number of fits given is a very important consideration. In schizophrenia a much greater number is indicated than in affective states. Meduna (1937) originally stressed the need for at least 20 fits in unremitting cases of schizophrenia, and most workers advocate this minimum in the absence of good remission, with increase to 30 or more where necessary (Cook, 1938*a*; Beckenstein, 1939; Ebaugh and Shanahan, 1939; Zeifert, 1941; Gonda, 1941; Kalinowsky and Worthing, 1943). When a good remission occurs early in treatment a further two to six fits are recommended before terminating the course (Meduna, 1937; Ebaugh and Shanahan, 1939; Zeifert, 1941; Kalinowsky and Worthing, 1943). Strecker *et al.* (1939) advised confining courses to ten fits with a view to avoiding cardiac damage, but this cannot be recommended if good results are to be obtained. Gonda (1941) and Impastato and Almansi (1942) believe that many workers have condemned convulsion treatment in schizophrenia because they have ended treatment too soon. The importance of giving adequate courses, convincingly shown by Zeifert (1941) and Kalinowsky and Worthing (1943), cannot be too strongly emphasized.

It is one of the peculiarities of convulsion treatment that relapses often occur within three or four weeks of an apparent good remission. These relapses can usually be aborted by immediately giving a short subsidiary course. For this reason Zeifert (1941) advocates keeping the patient under observation for four to six weeks after the end of treatment. Most workers will allow four weeks to be sufficient. Doubtless many of the relapses that mar the results of convulsion therapy in schizophrenia are due to too early release. Reznikoff (1940) considers there is a definite persistent tendency to relapse, and

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Ebaugh and Shanahan (1939) found 38 per cent. relapses after 1 to 17 months. Cohen (1939*a*), however, noted that 89 per cent. patients who had achieved a full remission remained well six months after treatment, and Kalinowsky and Worthing (1943) state, "Once a full remission is obtained, relapses in schizophrenics after ECT do not seem to be more frequent than after insulin treatment."

In affective states an average of less than ten fits is usually effective (Bennett, 1938, 1939; R. H. and G. A. Young, 1939; Gonda, 1941; Closson and Swaney, 1941; Kalinowsky and Worthing, 1943). Zeifert (1941) found 12 to 20 fits necessary in involutional psychoses, and Fitzgerald (1943) gave an average of 17 fits in 150 undifferentiated depressives. The same tendency to relapse within a few weeks of treatment is seen in affective as in schizophrenic states, with the same consequent necessity for keeping patients under observation for at least four weeks, if possible.

Subconvulsions.—It is natural to wish to avoid the somewhat barbarous complication of the major fit, and this desire has been encouraged by the minor and transient symptomatic improvements not uncommonly seen after one or two subconvulsive doses of cardiazol or ECT at the beginning of a course. Unfortunately subconvulsive treatment has proved to be disappointing (Furst and Stouffer, 1941; Flescher, 1942; Impastato and Almansi, 1942). Kalinowsky *et al.* (1942), treating 27 patients of various types with courses of subconvulsive ECT, obtained no recoveries and only 5 improvements. Subsequently 22 of these patients were given full convulsions with 7 recoveries and 9 improvements. Cohen (1939*b*) treated 19 patients with subconvulsive doses of cardiazol; 16 were unimproved, and of the three who improved two had two or more accidental convulsions. Later the 16 unimproved cases were given full convulsions with 2 recoveries and 5 great improvements. It is noteworthy that in cases reported as improved after subconvulsive courses accidental major fits have often occurred. Androp (1941) found subconvulsive doses, although less effective than convulsions, sufficiently encouraging to warrant further trial, and Young (1941) reported full recovery in one case of acute confusional hallucinatory reaction after nine phrenazol subconvulsive doses.

It is well known that patients often become more agitated and apprehensive after subconvulsive doses of cardiazol (Cottington and Gavigan, 1939), and E., E. S-. and L. Ziskind (1942) firmly believe subconvulsive doses predispose to therapeutic failure in proportion to the number of such doses.

Softening of fits.—In order to avoid traumatic and other complications and diminish the risk in treating elderly or infirm patients, convulsions may be modified or softened by means of curare, β-erythroidin hydrochloride, quinine methochloride, magnesium sulphate or spinal anaesthesia.

The curare modification is fully described by Bennett (1941) and Gray *et al.* (1941). Curare acts on the motor end-plates, inhibiting the action of acetylcholine. The average dose is 5–12 c.c. (1 c.c. for each 20 lb. body weight) of an aqueous solution, in which 1 c.c. contains 10 mgm. of the active principle, injected intravenously over a period of one to two minutes (Bennett, 1941) or half to one minute (Gray *et al.*, 1941). General muscular weakness results,

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reaching its peak about two minutes after the end of the injection (Bennett, 1941). The effect vanishes in 15 to 20 minutes, and the convulsion should be induced within three minutes of the end of the curare injection (Bennett, 1941; Gray *et al.*, 1941). The resulting fit is typical, but greatly softened, the usual violent clonic spasm being especially reduced. Paresis of respiratory muscles may lead to respiratory depression or failure requiring artificial respiration and the injection of prostigmin (Gray *et al.*, 1941; Woolley *et al.*, 1942). Three out of 50 cases reported by Gray *et al.* (1941) required these remedies. Charlton *et al.* (1942) reported a death from respiratory failure during curare-metrazol treatment.

The use of curare with ECT is said to be more dangerous than with cardiazol, because whereas cardiazol acts as a respiratory stimulant electro-convulsions tend to depress respiration (Worthing and Kalinowsky, 1942); Bellet *et al.* (1941) noted a serious form of arrhythmia following this combination. Cash (1942), however, claims to have used curare with ECT in 139 cases without mishap, and others recommend the combination (Furst and Stouffer, 1941; Woolley *et al.*, 1942; Shelton, 1942).

The efficacy of convulsion therapy appears to be in no way diminished by the softening of the fits (Bennett, 1941; Gray *et al.*, 1941; Harris *et al.*, 1941). Bennett (1941) found no material difference in the results of treating 99 patients suffering from affective psychoses with cardiazol alone and 64 comparable patients with curare-modified fits. This is a little surprising considering the unsatisfactory effect of subconvulsive treatment. The EEG after treatment is said to be the same as with cardiazol alone (Harris *et al.*, 1941; Bennett, 1941). There would appear to be some difficulty in ensuring that the fit occurs during the peak of curare activity, and injuries sustained during curare-modified fits have been attributed to timing errors (Bennett, 1941; Woolley *et al.*, 1942).

Quinine methochloride, β-erythroidin hydrochloride and magnesium sulphate all modify the convulsion similarly to curare. The β-erythroidin-metrazol combination is fully discussed and advocated by Rosen *et al.* (1940), but Williams (1941) gives a warning that β-erythroidin has definite toxic properties and that some individuals show marked cardiac susceptibility to it. Cottington (1941) has used this modification on children.

Quinine methochloride (Bennett and Cash, 1941) is a synthetic compound with a curare-like action. Its dosage is said to be more accurate and easily gauged than that of curare, but it provokes severer respiratory complications.

Magnesium sulphate (Yaskin, 1941) is given intravenously in a dosage of 25 to 30 c.c. of a 25 per cent. aqueous solution. Its effects pass off within ten minutes. Calcium chloride (10 per cent. aqueous solution) is recommended as an antidote (Yaskin, 1941). A case of sudden death immediately after the injection of 30 c.c. of magnesium sulphate solution has been reported (Rosenbaum and Lipton, 1942).

Spinal anaesthesia (Hamsa and Bennett, 1939; H. J. and L. M. Shorvon, 1943) has been employed to prevent injuries to the spine and lower part of the body. Its main use would appear to be in cases of pre-existing vertebral, hip or femoral disease or injury.

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All these modifications add a complication to therapy and have their own dangers. None of them can be unreservedly recommended for general use, but they may prove valuable in individual cases embodying special risks.

Various methods have been employed to eliminate or allay the feeling of dread associated with the cardiazol injection; these include general anaesthesia (Neustatter and Freeman, 1939; Fabing, 1942), insulin coma (Russell, 1938; Sands, 1939; Notkin *et al.*, 1943), hyoscine and morphine (Cook, 1938*a*), hyoscine alone (Edlin and Klein, 1940). Neither hyoscine nor morphine increase the convulsion threshold. These methods have been almost entirely obviated by the advent of ECT, but the occasional severely agitated, negativistic patient, who becomes terrified when approached for any treatment, may be saved much unnecessary suffering by an injection of morphine, gr. $\frac{1}{4}$–$\frac{1}{2}$, with hyoscine, gr. $\frac{1}{100}$–$\frac{1}{50}$, half an hour before treatment.

Dangers and Complications.

Deaths.—As regards cardiazol, Meduna and Friedman (1939), investigating 3,046 cases, found nine deaths (0·29 per cent.), and Kolb and Vogel's survey (1942) disclosed a death-rate of only 0·1 per cent. in more than 36,000 cases. Kinsey (1941), as a result of a nation-wide questionnaire (U.S.A. and Canada), as well as of collecting from the literature, reported 43 deaths associated with cardiazol treatment of 18,543 cases (0·23 per cent.). They concluded that six of these were apparently not caused by the treatment and 31 "not directly" due to treatment; 27 deaths followed pulmonary complications, including 12 from tuberculosis, and 9 were due to cardiac causes. When it is considered that all deaths occurring in association with treatment were included, it appears probable that less than two deaths per 1,000 cases were actually initiated by cardiazol fits. As far as can be assessed ECT is considerably safer. Impastato and Almansi (1942) could only find records of two deaths from ECT, and Kolb and Vogel (1942) four deaths in 7,207 cases.

Complications.—Excluding injuries produced in the fit, pulmonary complications are the most frequent and most serious. There is a definite danger of activating latent tuberculosis (Pameijer, 1938; Harris and Birnie, 1938; Steinberg and Nierenberg, 1939; Kraus and Viersma, 1940; Read, 1940; Colomb and Wadsworth, 1941; Furst and Stouffer, 1941). Bulley and Greene (1941) found tuberculosis in 8·3 per cent. of 277 schizophrenics over a period of three years after treatment, as against 3 per cent. in a comparable group of untreated schizophrenics. In nine of these cases the trouble started acutely within four months of the end of treatment. Chest fluoroscopy or radiography before treatment is recommended (Harris and Birnie, 1938; Blair, 1940*a*; Bulley and Greene, 1941). With care in selecting cases, thorough history investigation and complete physical examination, few cases of latent tuberculosis should be missed, and the tuberculosis activation rate of little more than 1 per 1,000, obtained by Kolb and Vogel (1942) from U.S. and Canadian figures, should not be exceeded. Lung abscesses (Pameijer, 1938; Beckenstein, 1939; Ross, 1939; Notkin *et al.* 1940) are found in about 0·1 per cent. of cases (Meduna and Friedman, 1939). They may be due to aspiration during or immediately after the fit or, in the case of intravenously induced fits, to

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mobilization of a thrombus at the site of injection (Zeifert, 1939). Pneumonia, both lobar (Ross, 1939) and aspiration (Novotny, 1939), is prone to occur. Lung abscesses and infarcts and aspiration pneumonia are often attributed to dental sepsis, and preliminary dental examination is essential.

Cardiovascular accidents are rarely associated with induced fits; Meduna and Friedman (1939) recorded acute myocardial collapse in only 0·06 per cent. cases. Transient ECG changes may occur after fits, probably due to cardiac anoxaemia (Good, 1940*a*; Levine *et al.*, 1940) or vagal irritation (Hoffmann *et al.*, 1940; Wender and Jezer, 1941). It is generally agreed, however, that reasonably healthy hearts incur no permanent damage (Good, 1940*a*; Messenger and Moros, 1940; Wender and Jezer, 1941), although Read (1940) found ECG changes in 5 out of 320 cases a year or more after treatment. Many patients with more or less severe cardiovascular disease have been successfully treated with both cardiazol and electric fits (Borgarello, 1939 [ECT]; Myerson *et al.*, 1941 [ECT]; Robinson and Shelton, 1940 [cardiazol]; E., E. S-. and L. Ziskind, 1942 [cardiazol]). Robinson and Shelton (1940) administered five cardiazol fits to a woman, aged 84, suffering from diffuse myocarditis, and six cardiazol fits to a man, aged 75, with cardiovascular degeneration; both are said to have recovered uneventfully. As regards choice of treatment in association with cardiovascular disease, cardiazol is a cardiac stimulant, but tends to produce stronger fits, while electro-fits tend to depress the cardiac system, but according to Jessner and Ryan (1942) the degree and frequency of cardiac complications are much less, because the fit is less violent. Several cardiac deaths have been reported (Pameijer, 1938; Hayman and Brody, 1939; Michael and Wittenbrook, 1940; Impastato and Almansi, 1942). Obviously each case must be treated individually; the severity of the mental condition and its suitability for other forms of treatment, especially leucotomy, as well as the physical state, must be considered. E., E. S-. and L. Ziskind (1942) give examples of patients, particularly involutional melancholics, deprived of convulsion treatment owing to cardiovascular or other physical disease, who have committed suicide or died of exhaustion, and consider "contra-indications based on physical disabilities may be over-emphasized." Smith *et al.* (1942) and Impastato and Almansi (1942) have reported "alarming apnoea" after electrically produced fits, but no untoward results have ensued.

Belated fits some minutes or even hours after the injection occasionally occur with cardiazol, probably due to some of the fluid finding its way outside the vein and exerting its influence later. *Status epilepticus* has been reported after cardiazol injections (Beckenstein, 1939; Becker and Stein, 1940; Zeifert, 1941) and one hour after an electro-shock (Bellet *et al.* 1941), but can easily be controlled by intravenous luminal or sodium amytal, and is not a serious or common complication.

Spontaneous epileptic fits starting some time after a course of convulsions are by no means uncommon (Read, 1940; Liebert, 1942). Pacella and Barrera (1942) found no case of spontaneous epilepsy in patients with normal pre-treatment EEG, but one patient with a suspicious EEG had a spontaneous fit four weeks after his course of ECT; they noted also that six epileptics, who were each given one electro-fit, suffered more *grand* and *petit mals* than

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usual during the following few days. Fortunately this epileptic tendency can be cut off with the ordinary anti-convulsants, and there does not appear at present to be any real danger of creating epileptics by the treatment.

The danger of producing permanent brain lesions such as occur in chronic epileptics has stimulated much animal experimentation with cardiazol and electric fits. This, together with the findings in human brains, is fully dealt with in the chapter on neuropathology.

No constant changes are seen either in animals or humans. When the animal is killed soon after one or a series of fits, widespread subarachnoid haemorrhages and punctate haemorrhages of the brain substance may be found (Alpers and Hughes, 1942; Heilbrunn and Weil, 1942). At a later stage mild ischaemic and glial reactions with occasional neurone damage are described. There is some evidence that the amount of damage has some relation to the quantity of cardiazol injected (Weil and Liebert, 1938) and to the total duration of convulsions (Strecker *et al.*, 1939; Cleckley, Bowles and Mettler, 1940). Many animals appear to escape damage even after multiple convulsions (Winkelman and Moore, 1940; Heilbrunn and Weil, 1942; Neumann *et al.*, 1942). It is noteworthy that monkeys, whose CNS approaches most nearly to that of man, show the least damage. Arieti (1941) found no lesions in two monkeys and hardly perceptible or very mild degenerative cell changes in three others. Strecker *et al.* (1939), examining the brains of seven monkeys which had received 67 to 147 minutes of convulsions, found no changes in three and mild cellular changes and subarachnoid haemorrhages in four. Finley and Brenner (1941) described small cortical foci, in which there were missing neurones and vascular damage, and scattered cortical areas showing glial cell proliferation and hypertrophy.

As regards human material, Weil and Liebert (1940), examining the brains of six patients who died two to ten months after cardiazol treatment, found hypertrophy and hyperplasia of astrocytes and to a lesser degree of microgliocytes. Whitehead *et al.* (1940) found scattered neurone damage and slight glial reactions in two cardiazol-treated cases, and Petersen (1939) generalized ischaemia of ganglion cells and diffuse gliosis also in two cardiazol cases. Mild glial changes of the type seen in epilepsy were noted in two cases examined by Meyer (1939). Glial reactions are the most frequent findings, but appear to be neither severe nor important.

Transient electroencephalographic changes normally accompany induced fits (Cook and Walter, 1938; Davis and Sulzbach, 1940). More persistent changes have been described; these usually clear up within three or four weeks (Polatin *et al.*, 1940; Hughes *et al.*, 1941; Impastato and Almansi, 1942; Levy *et al.*, 1942), but in isolated cases may still persist after six months (Pacella *et al.*, 1942) or a year (Davis and Sulzbach, 1940). This subject is fully treated in the chapter on electroencephalography.

A state of amnesia, varying from a mild tendency to forget names to severe confusion of the Korsakow's type, is often seen during and for a short time after a course of convulsions (Platner, 1938; Ziskind, 1941; Hemphill and Walter, 1941; Furst and Stouffer, 1941; Levy *et al.*, 1942; Smith *et al.*, 1942; Impastato and Almansi, 1942; Kalinowsky and Worthing, 1943). It may

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follow a single fit or be absent during an extensive course. There is some evidence that it can be correlated with abnormal EEG changes and that both tend to clear up together (Polatin *et al.*, 1940). Ziskind (1941) considers this condition undesirable and possibly harmful, and Dynes (1939) believes gross deterioration sometimes ensues. Some workers stop the course when it occurs, but the majority consider it no contra-indication to further treatment, and a few believe it may be of good prognostic significance (Shapiro and Freeman, 1939; Impastato and Almansi, 1942).

It is unusual for any appreciable defect to remain after a few weeks (Kalinowsky *et al.*, 1941; Hemphill and Walter, 1941; Levy *et al.* 1942; Impastato and Almansi, 1942), but occasionally recovery is not complete for several months (Furst and Stouffer, 1941; Ziskind, 1941; Smith *et al.*, 1942). Memory tests have produced conflicting reports. Tooth and Blackburn (1939) found memory defect still present six months after treatment in 5 out of 16 cases, while Sherman *et al.* (1941) could find no significant changes in 10 psychotics tested before, during and after treatment. Reports of memory disturbance lasting many months are very occasional, and at present there is little evidence that permanent intellectual defect is a practical danger.

Other neurological sequelae after induced convulsions are conspicuously absent.

Skeletal Complications.

Spine.—Because vertebral fractures are largely symptomless and only discoverable by radiography, they were not described until four years after the inception of convulsion therapy. Following the reports of single cases by Wespi (1938) and Stalker (1938) routine radiography of the spine soon revealed an alarming proportion of these fractures, and for a time the future of convulsion treatment was in serious jeopardy. Fortunately they are not followed by serious sequelae and have proved to be far less important than was at first feared.

The predominant lesion is a compression of one or more vertebral bodies (as many as five have been fractured in the same patient, Graves and Pignataro, 1940; Easton and Sommers, 1942), varying from slight deformity of the anterior margin to complete crushing of the whole body. Other less frequent and striking lesions are herniation of the nucleus pulposus of the intervertebral disc into neighbouring vertebrae, *knörpelnötchen*, etc. Fractures usually occur during one of the first few convulsions.

Incidence.—Polatin *et al.* (1939) found an incidence of 43·1 per cent., but later reports have tended to be far less alarming. An analysis of 16 papers dealing with cardiazol fits yields the much lower figures of 289 cases of fracture in 1,344 patients (21·5 per cent.). The reduction is probably due to added care in preventing fractures during fits and possibly to the elimination of old lesions by taking radiograms before as well as after treatment. The incidence in ECT appears to be very much lower, figures from five sources (Golla *et al.*, 1940; Furst and Stouffer, 1941; Smith *et al.*, 1942; Worthing and Kalinowsky, 1942; Barrett *et al.*, 1942) totalling 14 fractures in 371 patients (3·9 per cent.).

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Compression fractures also occur in patients subject to spontaneous major epileptic fits. Figures collected from nine sources show 64 cases of spinal fracture out of 381 patients (16·8 per cent.). The proportion is not much below that of cardiazol fractures. In a radiological survey of 143 consecutive cases treated with convulsions, 134 epileptics suffering from long-standing major fits and 135 controls, Cook and Sands (1941) found 14·7 per cent. cases of vertebral fracture in the treated group, 10·4 per cent. in the epileptics and 1·5 per cent. in the control group. A higher percentage for both groups (31·4 per cent. with induced fits, 34·2 per cent. in epileptics) was reported by Reed and Dancey (1940). Worthing and Kalinowsky (1942), however, reported no fractures in 60 patients undergoing ECT and only one in 42 epileptics. The discrepancies in these reports, more particularly as regards epilepsy, where incidence cannot be affected by therapeutic technique or prophylactic measures, show all too convincingly that radiological diagnosis of vertebral fractures is by no means an exact science.

Induced convulsion fractures mainly involve the mid-dorsal region (Graves and Pignataro, 1940; Krause and Langsam, 1941; Cook and Sands, 1941; Barrett *et al.* 1942; Easton and Sommers, 1942). Those associated with epilepsy are generally found in the lower thoracic and upper lumbar region (E. and E. S-. Ziskind, 1939; Cook and Sands, 1941). Barrett *et al.* (1942), however, noted a fairly even distribution from Thor. III to Thor XII in nine cases involving 19 vertebrae.

In view of this difference in distribution no absolute conclusion can be drawn from the absence of referable symptoms in long-standing epilepsy, but it is reassuring that neither Kümmel's disease nor spinal cord involvement occur as a result of epileptic fits.

The mid-dorsal fractures complicating induced fits are much more closely akin in distribution and nature to those associated with tetanus. They may be brought about by the abrupt flexion spasm, which often initiates both cardiazol and tetanic convulsions and which is less frequent in electro-convulsions and usually absent in epileptic fits. Worthing and Kalinowsky (1942) attribute the injuries to the short pre-convulsive "first clonic phase" seen in cardiazol fits (Strauss *et al.*, 1939) and also in tetanic seizures. Strauss *et al.* (1939) analysed the cardiazol fit by means of high-speed motion pictures, and pointed out that this first clonic phase is predominantly flexor, whereas in the second (main) clonic phase extension prevails. Dedichen (1939) believes that the severity of the tonic phase in cardiazol fits is the decisive factor. Most workers consider the fractures occur in flexion, but Tureen and Key (1940) believe they are produced during opisthotonos and are due to severe longitudinal compression of the spine; in their view the anterior part of the mid-dorsal vertebrae suffers most because even in opisthotonos the normal mid-dorsal curve persists. This explanation of the vulnerability of the anterior part of the body in the mid-thoracic region cannot be correlated with the fact that, when convulsion fractures do occur in the lumbar region, anterior wedging is equally characteristic. Furst (1940) has shown experimentally that much less force is required to crush the anterior-superior margin of the fifth thoracic vertebra than any other part of its body, possibly due to the construction of

TABLE I.—*Vertebral Fractures Due to Convulsions.*

Induced fits.	Thor. II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	Lumb. I.	II.	III.	IV.	Total Vertebrae	Total Cases.
Stalker (1938)	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	2	1
Wespi (1938)	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1	1
Graves and Pignataro (1940)	2	–	3	4	6	4	1	–	–	–	–	–	–	–	–	20	15
Cook and Sands (1941)	–	–	1	7	6	4	3	4	1	–	–	1	–	–	–	27	21
Krause and Langsam (1941)	–	–	11	17	15	12	6	3	2	1	1	1	1	–	–	70	32
Easton and Sommers (1942)	–	3	25	33	24	17	4	3	2	–	–	–	–	–	–	111	46
Barrett *et al.* (1942)	–	2	6	2	7	5	2	–	–	–	–	–	–	–	–	24	12
Total	2	5	46	63	59	44	16	10	5	1	1	2	1	–	–	255	128
Epilepsy.																	
E. & E. S-. Ziskind (1939)	–	–	–	–	–	–	–	–	1	1	1	–	1	1	–	5	3
Blair (1940*b*)	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	2	1
Cook and Sands (1941)	–	–	–	–	–	4	1	–	2	–	3	3	3	1	1	18	14
Worthing and Kalinowsky (1942)	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	1
Barrett *et al.* (1942)	–	2	2	2	2	4	2	2	1	1	1	–	–	–	–	19	9
Total	–	2	2	3	3	8	3	2	4	2	5	4	4	2	1	45	28

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its trabeculae. Easton and Sommers (1942) attribute the mid-dorsal localization to the fact that the extensor muscles are weaker and the intervertebral discs thinner in this region than elsewhere.

Symptoms.—The fractures are mostly symptomless and only revealed by routine lateral radiograms of the spine. These should be taken before as well as after treatment (Cook and Sands, 1941; Androp, 1941; Easton and Sommers, 1942; Impastato and Almansi, 1942) in order to eliminate old or doubtful lesions. Pain in the back and local tenderness are sometimes experienced (Bennett and Fitzpatrick, 1939; Wyllie, 1940; Graves and Pignataro, 1940; Easton and Sommers, 1942), but the degree of pain has little relation to the severity of the lesion (Polatin *et al.*, 1939; Cook and Sands, 1941).

Backache after convulsions is often of muscular origin and does not necessarily indicate vertebral injury (Cook and Sands, 1941). Referred pain has been reported in a small number of cases (Cook and Sands, 1941; Easton and Sommers, 1942), but usually clears up in a few weeks. Slight gibbus may follow severe crushes, and discomfort lasting many months has been reported in one case (Androp *et al.*, 1941), but few patients appear to be seriously inconvenienced (Jessner and Ryan, 1942). In spite of the many thousands of convulsion courses given no serious permanent disability has been reported. This is all the more reassuring as delayed vertebral collapse (Kümmel's disease) tends to occur during the first year after injury.

Only when pain is intense or the lesion sufficiently severe to suggest the possibility of subsequent kyphus does treatment appear to be necessary; in such cases a plaster jacket or brace is usually applied. It is generally agreed that mild or symptomless fractures, revealed by radiography, do not preclude further fits. Some workers (Krause and Langsam, 1941; Easton and Sommers, 1942) do not regard kyphosis, scoliosis or herniation of the nucleus pulposus as contra-indications, but severe spinal distortions obviously afford some risk of cord injury. Vertebral fractures would appear to be more prevalent in the elderly and those with long-standing illness (Meduna and Friedman, 1939; Graves and Pignataro, 1940), but Hemphill and Walter (1941) believe fit and muscular subjects are a greater risk; evidently they consider muscular strength a more important factor in producing spinal fractures than bony weakness. Osteoporosis is usually considered a definite contra-indication (Krause and Langsam, 1941; Easton and Sommers, 1942). Evans (1941, 1942), however, relates the astonishing case of an agitated melancholic suffering from generalized osteoporosis and marked dorsal kyphosis, who, all other treatments having failed, was subjected to cardiazol convulsions. Despite the occurrence of a fracture of the neck of the humerus during the third fit, six more convulsions were eventually administered without further incident; the mental symptoms disappeared.

Prevention.—Of the various measures taken to prevent these fractures hyperextension of the trunk on a hard couch or table with a pillow or sandbags under the mid-dorsal region and counter pressure on shoulders and hips (Cheney *et al.*, 1941*a*; Worthing and Kalinowsky, 1942; Easton and Sommers, 1942) appears to be the most popular; additional immobilization of arms and legs is practised by some (Dedichen, 1939; Furst, 1940; Moore and Winkelman,

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1941), but may increase the risk of the much more serious accidents of long bone fractures. Furst (1940) claims to have reduced the incidence of cardiazol vertebral fractures to 8 per cent. by his extension method of complete immobilization.

More heroic measures are recommended by others. Curare has been used successfully with cardiazol (Bennett, 1941; Gray *et al.*, 1941; Harris *et al.*, 1941; Woolley *et al.*, 1942) and with ECT (Cash, 1942; Shelton, 1942; Woolley *et al.*, 1942), while other fit-softening modifications (*q.v.*) have their advocates. They are doubtless able to reduce the risk of vertebral fractures to a minimum, but add a complication of some danger and should be reserved for cases involving high fracture risk.

It is now generally felt that the possibility of vertebral injuries should in no way preclude convulsion treatment. With the advent of ECT the incidence has been very much reduced, while added safeguards are immobilization of the spine in hyperextension and, in bad fracture risks, preliminary curarization or spinal anaesthesia. Worthing and Kalinowsky (1942) echo the general opinion in stating that vertebral fractures are largely preventable and if they do occur have no clinical importance.

Other bone injuries.—Fractures or fracture dislocations of long bones, although less common than vertebral injuries, are far more serious. Incidence is not easy to assess because of the tendency to publish such serious injuries as a warning to others immediately they occur or without reference to the number of cases treated. Table II shows the main fractures from ten sources, each dealing with at least 100 cases.

TABLE II.—*Skeletal Fractures (Excluding Vertebrae).*

Cardiazol.	Cases.	Femur.	Humerus.	Pelvis.	Scapula.	Jaw.	Radius.	Total.
Pameijer (1938)	1,200	5	3	—	3	1	—	12
Pollock (1939)	1,140	5	2	—	—	1	—	8
Beckenstein (1939)	232	2	—	—	—	—	—	2
Kwalwasser (1940)	425	2	1	—	—	—	—	3
Reznikoff (1940)	100	—	—	—	1	—	—	1
Notkin *et al.* (1940)	100	—	1	—	—	—	—	1
Zeifert (1941)	372	2	1	—	1	—	1	5
Cheney *et al.* (1941*a*)	112	—	—	—	—	—	—	0
Total	3,681	16 (·43%)	8 (·22%)	—	5	2	1	32 (·87%)
ECT.								
Furst and Stouffer (1942)	250	—	—	1	—	—	—	1
Smith *et al.* (1942)	156	—	2	—	1	—	—	3
Total	406	—	2	1	1	—	—	4
Full total	4,087	16 (·39%)	10 (·24%)	1	6	2	1	36 (·88%)

Fracture of the neck of the femur is the most frequent and serious injury and is not uncommonly bilateral (Pameijer, 1938; Walk and Mayer-Gross, 1938; Somers and Richardson, 1939; Cummins, 1940; Krause and Scherb, 1941; Androp and Green, 1941). Deaths following this complication have

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been reported by Beckenstein (1939) and Bellenger (1939). Pelvic fractures, usually through the acetabulum, are very much rarer (Nyberg, 1938; Hamsa and Bennett, 1939; Furst and Stouffer, 1942; E., E. S-. and L. Ziskind, 1942). Fractures of the humerus are often associated with dislocation of the shoulder. Zeifert (1941) mentions a fracture of the head of the radius. Mandibular fracture (Pameijer, 1938; Pollock, 1939; Carp, 1939) is undoubtedly rare, although symptomless dislocations are numerous. Simple shoulder dislocations can usually be reduced quite easily before the patient regains consciousness and can subsequently be prevented by appropriate restraint. It will be seen that all fractures are rare, those of the femur (0·39 per cent.) and the humerus (0·24 per cent.) being the commonest. The proportion of all fractures (0·88 per cent.) is comparable to Meduna and Friedman's figure of 1·1 per cent. in over 3,000 cases for all mechanical complications exclusive of temporo-mandibular dislocation. Neither collection includes vertebral fractures.

Meduna and Friedman (1939) believe that emaciated and long-bedridden patients are particularly susceptible to long bone fractures because of an avitaminosis affecting calcium metabolism. There appears to be considerably less risk of fracture with ECT than with cardiazol (Smith *et al.*, 1942).

Prophylactic measures vary from total immobilization of the legs in extension and arms in flexion and adduction across the chest (Furst and Stouffer, 1941) to complete absence of restraint. Zeifert (1941) attributes some long bone fractures to restraining the limbs.

Curarization and other fit-softening modifications almost entirely eliminate the risk of fracture, as does spinal anaesthesia for the lower part of the body, but cannot as yet be recommended for routine usage.

Contra-indications.

The more important contra-indications have been discussed in the preceding section. Androp (1941) gives the following list: acute infections and febrile diseases; advanced heart and kidney diseases; bone atrophy in long bedridden patients; pronounced spinal curvature and osteoarthritis; severe thyrotoxicosis; malignancy; thrombophlebitis; advanced general arteriosclerosis. Gonda (1941) also gives the first five of these conditions. Hemphill and Walter (1941) advise against giving ECT during vaccine therapy or in the presence of organic CNS disturbance. The latter should not be considered an absolute bar, as states of depression associated with chronic epidemic encephalitis have responded excellently and without mishap to convulsion treatment. The most important absolute contra-indication is tuberculosis, even if only latent. Menstruation is not generally considered a bar (Gonda, 1941; Impastato and Almansi, 1942).

There is some controversy as to the advisability of giving convulsions in out-patient clinics, private homes, etc. As regards cardiazol fits the practice is generally condemned, and Bennett (1939) considers they should be given "only in well-equipped psychiatric departments by experienced psychiatrists and psychiatric nurses." Kalinowsky and Barrera (1940) also think cardiazol

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convulsions inadvisable for out-patients, but recommend ECT. ECT, with its freedom from distress and less severe sequelae, is obviously the less objectionable method and has a number of advocates (Strauss and MacPhail, 1940; Hemphill and Walter, 1941; Myerson *et al.*, 1941; Impastato and Almansi, 1942). Mayer-Gross (1941), however, has pointed out that late fits have occurred and that states of confusion and aggressiveness and exacerbations of manic and depressive episodes are not rare, even after electrically-induced fits. Perhaps the most important drawback to out-patient convulsion treatment is the difficulty in getting patients to return for further treatments when once they begin to feel better.

There are undoubtedly many patients, particularly mild depressives, preeminently suitable for convulsion therapy, who will not agree to become in-patients, and it is obviously wrong that they should be debarred from treatment if some compromise can be effected. It is perhaps fair to say that ambulatory ECT should only be administered where the patient can remain under skilled observation for several hours after treatment and can be kept in hospital overnight, if any emergency warrants this course. The importance of completing a definite course of treatment should be continually and forcibly impressed upon the patient.

Theories of Action.

Meduna's original theory of a biological antagonism between epilepsy and schizophrenia has long been discarded, but no fully satisfactory explanation of the therapeutic mechanism of convulsion treatment has taken its place. There is, however, overwhelming evidence that the major fit itself provides the main therapeutic force. Hypotheses may conveniently be divided into psychogenic and physiogenic.

Psychogenic theories.—In the early days of cardiazol convulsions, when the severe apprehension and horror of many of the patients was perhaps the most striking single characteristic of the convulsion episode, all therapeutic benefit was not unnaturally attributed by the psychogenetically minded to the emotional shock produced by the pre-convulsive aura (Humbert and Friedmann, 1938; Meier, 1938; Lipschutz *et al.*, 1939; Good, 1940*b*). Experimental and statistical work on the therapeutic effect of the fear reaction soon showed that it played no important part (Low *et al.*, 1938; Cohen, 1939*b*; Cook, 1940). The altogether poorer effects of subconvulsive doses (Furst and Stouffer, 1941; Flescher, 1942; Impastato and Almansi, 1942), which certainly produce a longer and more severe period of unpleasantness, and finally the advent of ECT, with its instantaneous unconsciousness without any aura, have conclusively invalidated this hypothesis.

More tenable psychogenic theories depend upon an identification of the sudden unconsciousness with death and upon the effect of the "rebirth" on the psyche. Schilder (1939) points out the friendliness of patients in the post-convulsion state, even when still confused; the previous libido-fixations have lost their importance and there is renewed interest in the persons next to the patient. He believes the hypomanic elation which so often follows the epileptic attack is the joy of rebirth. Hemphill (1940) suggests that the period

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of dependence after the fit tends to lead to a breaking of the psychotic withdrawal from society. He also points out that the epileptic experiences his personality as a whole, even to an exaggerated extent, while the schizophrenic's personality is split up, and suggests that the fit may help to integrate the personality. Flescher (1942) rejects the fear *motif* because (1) electrically produced *petit mals* give poorer results than convulsions, although the patient suffers the same pre-unconsciousness experiences, and (2) he has observed suicidal depressives abandoning their suicidal tendencies after a few fits. The death threat, he notes, could scarcely heal the self-destructive tendencies in these cases. He formulates an interpretation based on Freud's theory that melancholy after the loss of a dearly loved person depends on a strong ambivalent attitude towards that person. The lost object is identified with the ego, and aggressiveness, previously unconscious, is directed against it in the form of self-depreciation, self-destructiveness, guilt feelings, etc. The fit, he maintains, by its severe motor manifestations " discharges " large amounts of energy inherent in the destructive and death drives and unloads them in an individually and socially harmless manner. Postulating life as an eternal struggle between Eros and Thanatos, he considers the " discharging function " of convulsion therapy as a precious support for Eros. Glueck (1942) believes the sedative effect of the physically induced oblivion is of great importance in the psychodynamics of the patients' recovery.

Most of these psychogenic theories attribute the therapeutic benefit to the unconsciousness rather than the convulsion. If this were true any method of producing rapid unconsciousness should prove equally effective. But it is well known that amytal, evipan and other coma-producing drugs are far less effective than convulsions.

Some regard convulsions as merely adjuvant to psychotherapy and more general treatment by virtue of their effect of rendering patients more accessible. Cheney *et al.* (1941*a*) believe that symptoms only are alleviated, without materially affecting underlying pathological processes and that convulsion therapy is useful only in so far as it facilitates the total psychotherapeutic effort. Rapid, complete and seemingly permanent recoveries, however, have unquestionably been effected by induced convulsions in circumstances where psychotherapy could play no part. This in no way detracts from the obvious importance, stressed by many experienced workers (Meduna, 1937 ; Humbert and Friedemann, 1938 ; Cummins, 1940 ; Androp and Green, 1941 ; Gonda, 1941), of explanation, re-education and, where necessary, more intensive psychotherapy during the improvement process.

Physiogenic theories.—Many of the physiogenic views propounded are highly speculative and need but brief mention. Among these are : alteration of cerebral water balance (Wilmanns, 1938), irritation of the cell membrane, stimulating cell permeability (Georgi, quoted by Müller, 1939). Meduna and Friedman (1939) have suggested that metrazol directly irritates the medulla, with resultant respiratory, vasomotor and autonomic reactions, but this theory does not appear to take into account the convulsion, which Meduna previously stressed as the essential factor. Tillim and Squires (1942) consider improvement is probably the result of improved general physiological functioning and

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not through direct action on the brain. Some consider convulsion therapy acts by stimulating the mid-brain vegetative centres and autonomic nervous system (Pfister, 1938; Ewald, quoted by Müller, 1939; Hoffman, 1942). Gellhorn (1938) believes that schizophrenia involves hypofunction of the sympathetic division of the autonomic system, and that metrazol fits exert their effects by stimulating this division. But, as Himwich has pointed out, adrenalin and other sympatheticotonic drugs are useless in the treatment of schizophrenia. 'Angyal (1937) has suggested that the results are achieved by stimulation of diseased ganglion cells by hyperaemia following ischaemia, possibly through flushing the brain of toxins.'

More important theories are concerned with anoxaemia. That marked anoxaemia does occur in convulsions has been amply proved by Himwich and his co-workers, who have shown that during cardiazol fits the oxygen saturation of the blood falls to 42 per cent. (Himwich *et al.*, 1939) and that it is also decreased in electric fits and when fits are modified by curare or β-erythroidin (Himwich and Fazekas, 1942). Reduction also takes place when cardiazol, insulin or potassium cyanide are given without fits (Himwich and Fazekas, 1942). Oxygen saturation may be reduced still further by nitrous oxide inhalation (Himwich and Fazekas, 1942) or by nitrogen inhalation (Lipetz, 1940). Lipetz (1940) postulates the same action with the use of insulin, induced fits or nitrogen inhalation, the main difference being that insulin takes hours, while fits or nitrogen take seconds. That this is not the whole story is evident, if only because insulin produces its best results on schizophrenics, even when they show affective shallowness and thought disorder, while convulsions act best on patients with severe emotional overactivity, whether they be depressives, manics or cases of schizophrenic reaction. Furthermore, nitrous oxide and nitrogen inhalation, which should theoretically be more effective than convulsions by virtue of the more severe oxygen deprivation, have not in practice proved to be so. Ebaugh and Shanahan (1939) found "slightly" encouraging results with nitrous oxide and Lipetz results with nitrogen inhalation in 13 cases were promising, but Fogel and Gray's results (1940) with nitrous oxide inhalation in 24 schizophrenics were not very convincing, and Green and Adriani (1940) found nitrogen effects "strikingly neutral." Too few cases have been treated by these means to be dogmatic, but published results certainly show no superiority of direct oxygen depletion methods over convulsions. Bennett (1939) supports the anoxaemic theory, advocating prolonging the anoxia by closing the nose and mouth for half to one minute after the end of the fit.

The weight of evidence and opinions heavily leans towards the viewpoint that the convulsions exert their effect by putting groups of cerebral neurones out of action, whether by anoxaemia or other means. The correlation between leucotomy and convulsion therapy strongly supports this view. Leucotomy, which certainly cuts out large groups of cells, is most effective in the same types of case most favourable to convulsion therapy, Golla (1943), in fact, regarding ECT as a temporary leucotomy. This knowledge, to be of any use, however, must be correlated with the mental improvement, and we are still faced by the question—how is the improvement effected? E., E. S-. and L. Ziskind

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(1942) correlate the memory disorder, which they point out is of the organic type, with the improvement; they look upon the amnesia as the loss of a normal function, the recovery as the loss of an abnormal function. It has been suggested that the temporary brain cell damage causes a break in tension which enables a more rational attitude to be adopted later (Shapiro and Freeman, 1939), and that the general depression of activity following the fits, when restored, becomes normal activity (Birkmeyer, quoted by Kennedy, 1940). Müller (1939) quotes the view, originated by Stief and supported by Küppers, that the main effect of the convulsions is to knock out, transiently or permanently, diseased nerve-cells which are less resistant than healthy cells, and Bowman (1939) believes that the convulsions, by destroying dominating pathological cells, enable dominating healthy cells to exert their influence. Himwich and Fazekas (1942) suggest, "It may be that depression of brain metabolism with eclipse of cortical functions facilitates behaviour changes by permitting an expression of the more primitive cerebral mechanisms mediated by the subcortex but ordinarily held in cortical control." They point out that this view affords an excellent example of the Jacksonian conception of evolution and dissolution of the central nervous system, temporary dissolution resulting from the treatments. Berrington (1939) has evolved a similar conception of depression of cerebral metabolism, produced by areas of cerebral anaemia.

Results.

Although individual workers may have greater faith in one or other of the methods of inducing fits, there is no serious evidence that the method of induction—cardiazol or other drug injection or electric shock, with or without modifications—makes any significant difference to the results.

It has been shown conclusively that the fit, or rather the bodily changes set up by the fit, is the radical therapeutic factor and that subconvulsive twitchings or unconsciousness without convulsions cannot take the place of the fit.

Results of convulsion treatment will therefore be taken as a whole under clinical headings.

Schizophrenia.

Convulsion treatment came into being as a rational measure against the specific mental disorder of schizophrenia. There is therefore more than a touch of irony that convulsions have been found quite empirically to be of the foremost importance in the treatment of affective states, while, after nine years, controversy still rages as to their value in schizophrenia.

Evaluation of results in schizophrenia is beset with difficulties. Statistical assessments are particularly fallacious, as they depend on several factors which may vary infinitely with the individual investigator. The two main variables are the diagnosis and the standard of remission. Schizophrenia has no clear-cut diagnostic frontier. There is a no-man's land of "acute schizophrenic reaction states," "confusional psychoses," "atypical schizophrenias," etc., which tend to run a self-limited course. These states are included under schizophrenia in varying degrees, which considerably alter the balance of results.

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The standards of recovery, remission, etc., give even greater opportunities for discrepancies. Many will support Bleuler in refusing to admit full recovery in schizophrenia, but if so high a standard of normality be maintained, a significant proportion of the general population would not pass muster. To avoid so absolute a label as recovery the term remission has become popular, but unfortunately the term, with its many qualifications, is referred to anything from full recovery to material improvement.

Enough has been said to dissipate any surprise that spontaneous remission-rates for schizophrenia vary from *nil* to 48 per cent. under different observers. Treatment figures are even less reliable owing to the additional variable of case-selection. Some workers exclude all but frank endogenous schizophrenias; many give the more hopeful cases every chance of spontaneous remission before considering convulsion treatment. At the other end of the scale are workers who do not think it worth while to treat cases of insidious onset showing the hall-marks of endogenous schizophrenia and confine convulsion therapy to acute schizophrenic reaction states. The statistical differences in results from this factor alone are obvious.

Other variable factors influencing treatment figures are (1) the subjective bias of the investigator, (2) the influence of adjuvant treatment—psychotherapy, intensive occupational therapy, etc.—(3) the adequacy of the course of treatment.

Criteria of Remission.

It is generally agreed that recovery and complete or full remission are synonymous terms and should imply freedom from all symptoms, good insight and an ability to take up one's former employment or mode of occupation and place in society. Other grades of remission, great improvement, etc., have too many shades of meaning to be of much statistical value. It would be helpful if the term remission were confined to patients who at least had lost all symptoms of their incapacitating illness and were able to live a relatively independent existence outside hospital.

Treatment Results.

The relation between prognosis and length of illness is so constant that tabular results without classification into illness durations are virtually useless. Meduna's original figures were 91 per cent. remissions for schizophrenic illnesses of under one year's duration, 50 per cent. between one and two years, and 12 per cent. over two years. Although more recent figures are generally lower the ratio remains undisputed. Meduna and Friedman (1939) collected the results of 2,937 cardiazol-treated schizophrenic psychoses from 17 European and 37 American centres. Of the 1,472 European cases 50 per cent. (290 out of 584) of the cases below 18 months' duration were said to have attained full remissions as against 13 per cent. (101 out of 751) of those over 18 months. Of the 1,465 American cases, 49 per cent. (202 out of 411) of those under one year's duration were classed as full remissions as against 8·4 per cent. of those who had been ill for more than one year.

Reitmann (1939), from a collection of 840 schizophrenics of under 18 months'

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duration treated by cardiazol fits in various parts of the world, compiled the following table:

	Cases.	Full remissions.
Austria	64	32 (50%)
England	31	13 (41%)
Germany	129	51 (39%)
Hungary	178	94 (53%)
Italy	53	42 (79%)
Switzerland	51	22 (43%)
U.S.A.	334	183 (54%)
Total	840	437 (52%)

Many recent statistics have not specified illness durations, so that there are surprisingly few suitable figures to draw upon in proportion to the mass of treatments given and papers published. A summary of results from five sources (Nyberg, 1938; Meier, 1938; Read *et al.*, 1939; Delgood, 1939; Cummins, 1940) dealing with 142 cases of under 18 months' duration shows 44 (31 per cent.) full remissions, 32 (22·5 per cent.) social or good remissions and great improvements, 37 (26 per cent.) improvements and 29 (20·5 per cent.) no improvements. Martinengo (1939) assessed his complete remission-rate for schizophrenics under 18 months' duration as high as 75 per cent. and contrasted it with a rate of only 5 per cent. in cases over 1½ years' duration.

As regards cases under six months' duration a summary from seven sources (Meier, 1938; Nyberg, 1938; Hahnemann, 1939; Read *et al.*, 1939; Cummins, 1940; Reznikoff, 1940; Zeifert, 1941) gives these figures: Full remissions, 76 (43·4 per cent.); social, etc., remissions, 46 (26·3 per cent.); improved, 38 (21·7 per cent.); not improved, 15 (8·6 per cent.); total, 175. Zerbini (quoted by Müller, 1939) obtained 65·4 per cent. remissions in 182 cases, Kalinowsky and Worthing (1943) 67·4 per cent. remissions in 46 cases, and Beckenstein (1939) found that 69·6 per cent. of 23 cases became well enough to be paroled from hospital and 91·3 per cent. showed definite improvement.

Taking one year as the assessment factor, remission-rates show but a medium fall, Zerbini giving 62 per cent., Cohen (1939*a*) 59 per cent., and Kalinowsky and Worthing (1943) 56·8 per cent.; Corwin and Voth (1941) contrast their remission-rates of 60 per cent. for cases under one year's duration with 20 per cent. for those above that period.

These results differ strikingly from those of Pollock (1939) and Kwalwasser (1940). Pollock, surveying the results of convulsion treatment in the New York State Hospitals, gives percentage figures for the various durations; these work out as approximately 9·6 per cent. recovered and 31·1 per cent. much improved in cases under six months' duration, and 7·1 per cent. recovered and 30·3 per cent. much improved in cases under one year's duration. Kwalwasser, also supplying only percentage figures, found no recoveries at all; 18·5 per cent. of 16 cases under six months were much improved, as were 33·3 per cent. of 30 cases of six to twelve months' duration and 13·8 per cent. of 80 cases whose illness had lasted one to two years; above two years the ratio

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fell to approximately 2½ per cent. The fact that no single recovery was reported among Kwalwasser's 425 cases and that in Pollock's survey one hospital reported no recoveries in 275 cases and another 5 in 329 cases, suggests that some cautiousness in assessing recovery more than any other factor is responsible for the very low figures. This view is supported by Kwalwasser finding no recoveries or great improvements in five "depressed manic-depressives" treated by convulsions. Surveying all the various opinions I think it is justifiable to assume that between 55 and 60 per cent. of cases of schizophrenia, including schizophrenic reaction states, treated by convulsions in the first year of their illness may be expected to remit sufficiently to take their former place in society.

As regards more chronic cases *complete* recovery is rare, for as Bowman (1939) has pointed out, "it can hardly be expected that one is going to make an ideal personality out of a schizophrenic patient who has been treated," just as " . . . a patient who has had pneumonia may never completely recover so that his lungs are as good as they were before the attack." In this connection the preference of Kalinowsky and Worthing (1943) for the common term "remission," denoting absence of any active psychotic symptoms and ability to take up a former life in the community (as against a division into "recovered" and "greatly improved"), provides a more reasonable working basis for assessing results.

The value of convulsion treatment in schizophrenia dwindles rapidly with length of illness and in the later stages there is probably little or no greater prospect of lasting remission than may occur spontaneously. Social remissions of a degree allowing any real independence are probably from 5 to 10 per cent. after two years' illness, and almost certainly less than 5 per cent. after three years'. Improvement in conduct, however, is often seen. Cohen (1938) treated 40 schizophrenics showing chronic excitement and overactivity with marked success. Overactivity, aggressiveness, destructiveness and incontinence were much improved, the necessity for sedatives dropped to vanishing point and about half became capable of productive work. Good results are claimed by many others (Cook, 1938*a*; Bellenger, 1939; Sogliani, 1939*b*; Phillips and Duncan, 1940; Hemphill and Walter, 1941; Zeifert, 1941). Unfortunately these symptomatic improvements are mainly transient. A substantial number of more permanent conduct improvements may be expected, however, if advantage is taken of the more accessible phase produced by an adequate course of convulsions, which may include weekly maintenance doses over a period of several months, to implement intensive rehabilitation in the form of occupation therapy, physical drill and games, as well as psychotherapeutic encouragement and explanation.

Stuporose patients usually improve rapidly under treatment, and as a rule become more accessible, take their food satisfactorily and cease to be incontinent after a few fits, but tend to relapse when treatment is stopped. A phase of catatonic excitement may be precipitated in chronic stupor states. Kalinowsky and Worthing (1943) observe that deeply regressed, quiet, deteriorated schizophrenics may become chronically disturbed and should not be treated.

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Prognostic Factors.

Next to duration by far the most important single prognostic factor in schizophrenia is the type of onset. This is well recognized as regards spontaneous remissions (Langfeldt, 1937), but has not been sufficiently stressed with reference to convulsion treatment. Rapid onset, particularly on a background of normal personality, offers the most favourable of prognoses whatever the clinical picture (Cook, 1938*b*); insidious onset emerging imperceptibly from adolescent schizoid personality is practically hopeless (Cook, 1938*a*). Kalinowsky and Worthing (1943) found that of 74 cases with remission the onset was described as acute in 58 and insidious in 16; in 57 unimproved patients the onset was apparently acute in only 19 and insidious in 38. They conclude that "insidious onset is of ominous significance."

The significance of regression (Beckenstein, 1939), dissociation (Cook, 1938*b*), and affect loss (Rosal, 1939) in prognosis is important. Cases with lively affect, particularly with hallucinations producing agitation, apprehension and horror, may be confidently expected to do well; those with flattened affect and pronounced apathy, possibly in the face of hallucinations and delusions of a profoundly distressing character, are usually therapeutic failures.

Comparative prognosis of the various sub-types of schizophrenia is vitiated by the fluidity of the classification as well as by the factors of length of illness, type of onset and emotional content. It is generally agreed that young hebephrenics are the least favourable sub-type (Pollock, 1939; Notkin *et al.*, 1940; Kalinowsky and Worthing, 1943), despite Meduna's original contrary opinion. Kalinowsky and Worthing (1943) consider paranoid schizophrenia with delusions and hallucinations to have the best outcome; Beckenstein (1939) gives "paroled" figures of 30·8 per cent. for paranoids, 23·6 per cent. for catatonics and 14·3 per cent. for hebephrenics. Here again a change of view is noticeable, mainly due to the realization that the striking early improvements in catatonic stupors tend to be superficial and transient. Catatonics of short duration react dramatically to a few fits, but improvement is maintained longer in paranoid patients (Reznikoff, 1940). Kolb and Vogel's survey (1942) reveals the general view of American hospitals that catatonic states are the most suitable for convulsion treatment.

Remitting cases.—Patients liable to recurrent schizophrenic attacks bear a good treatment prognosis (Reznikoff, 1940; Kalinowsky and Worthing, 1943), which tends to be more nearly relative to the length of the immediate attack than to that of the total psychotic history.

Children.—Cottington (1941) records improvement in eight out of nine schizophrenic children aged 6 to 14 years, treated with cardiazol fits modified by β-erythroidin hydrochloride. The danger of producing epilepsy is likely to be very much greater in childhood, and should be seriously considered before convulsion treatment is prescribed.

Evaluation.

Spontaneous remissions.—The average spontaneous remission-rate for unselected cases of all types and durations of schizophrenia has been estimated by Müller as probably between 15 and 20 per cent. Ebaugh and

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Shanahan (1939) give a comparable figure of 10–30 per cent. While bearing in mind how many factors are bound to vitiate any conclusions in this field, it is clear that the majority of published findings reveal a much higher remission-rate in schizophrenics treated by convulsions in the first 18 months of their illness. Any complacency, however, as to the results of convulsion treatment in schizophrenia must be shaken by the detailed analyses of results at the New York State Hospitals by Malzberg (1938), Pollock (1939), and Ross and Malzberg (1939). These analyses showed 11·1 per cent. recoveries and 26·5 per cent. great improvements with insulin therapy, 3·5 per cent. recoveries and 11·2 per cent. great improvements in cases not treated by shock methods, and only 1·6 per cent. recoveries and 9·9 per cent. great improvements with metrazol fits. While these papers have exerted a profound influence and engendered a much more critical attitude among investigators, it is only fair to say that other workers do not confirm these findings. Androp and Green (1941), comparing 82 schizophrenics of durations averaging 4½ years with 212 unselected untreated schizophrenics, noted that 18 per cent. of the treated cases were able to leave hospital with " social improvement " as against only 5 per cent. of the untreated group. Notkin *et al.* (1940), in a somewhat similar investigation, found 18 per cent. improvements in their treated, and 8·4 per cent. in their untreated group. Such discrepancies only serve to emphasize the difficulties of evaluation.

Insulin and convulsion treatments.—It must be emphasized that there should be no rivalry between insulin and convulsion therapy. The two treatments are complementary, and do not influence the various schizophrenic types equally. Insulin is said to be more successful in clearing up thought disorder and affect loss, and therefore tends to produce better results in true schizophrenia. Convulsions are the method of choice with florid symptomatology and retained affect. The type of case likely to do well with one or the other method can be fairly well estimated and the more favourable method given first. While more cases are likely to benefit from insulin it is advisable to give convulsion therapy prior trial, whenever there is a reasonable prospect of benefit, owing to its shorter duration and greater simplicity, safety and economy. In all probability insulin is the more consistently beneficial over all types of schizophrenia (Ross and Malzberg, 1939; Bowman *et al.*, 1939; Müller, 1939; Weinberg and Goldstein, 1942), but Kalinowsky and Worthing (1943) stress the similarity of results when schizophrenia is adequately treated by either method.

Combined insulin-metrazol treatment has been advocated (Georgi and Strauss, 1938; Russell, 1938; Tillim, 1940; Notkin *et al.*, 1943), but its most cogent *raison d'être*, to eliminate the fear associated with the induction of cardiazol fits (Russell, 1938; Sands, 1939; Notkin *et al.*, 1943), has been removed by ECT. Müller (1939), collecting results of insulin, cardiazol and combined treatment from German University Clinics, reported 40·3 per cent. cases symptom-free after the combined method, as against 37·7 per cent. with insulin alone and 18·9 per cent. with convulsions alone. Statistical results of the combined method can have no validity, however, unless compared with a similar series of patients who have had the opportunity to receive both treatments, if necessary. Although the main reasons for simultaneous combined

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insulin-convulsion treatment are no longer valid, both treatments should be available for every case. In many schizophrenic states there is an obvious emotional component, e.g. agitation, apprehension, etc., which may clear up under convulsions, leaving the underlying thought disorder wholly or partially untouched. A course of insulin, possibly shorter and less deep than when given as the sole treatment, may then suffice to remove the remaining symptoms.

Apart from numerical considerations certain other aspects must influence any evaluation of treatment. Doubtless many schizophrenics discharged after convulsion treatment would eventually have recovered spontaneously, but it is generally agreed that their period of hospitalization is markedly shortened by treatment (Meduna and Friedman, 1939; Cummins, 1940; Reznikoff, 1940; Androp and Green, 1941). Cheney *et al.* (1941*a*) adopt an admirably conservative viewpoint in stating " . . . metrazol treatment brings about a change which facilitates other forms of treatment and accelerates recovery, so that hospitalization is shortened, sometimes in a strikingly dramatic manner." The quality and length of treatment remissions as compared with spontaneous remissions is not so easily settled. Meduna and Friedman (1939) and Cummins (1940) consider treatment remissions superior both in quantity and quality, and, although Notkin *et al.* (1943) hold the contrary view, personal experience convincingly supports the former opinion.

Lastly, the attitude of the patients towards treatment must be considered. Weinberg *et al.* (1940) studied the reactions of 24 cases of spontaneous recovery, and 24 similar cases recovered after insulin or convulsion treatment; of these, 12 in each group were schizophrenics. They found that the former tended to have a real dread of the disease, and to worry that a relapse would place them in hospital for life. The treated group did not brood over the psychotic episode and felt that, if they became ill again, there was a remedy. In addition they felt that the hospital had done everything possible to get them well, whereas the spontaneously recovered group were apt to credit time and not medical aid for their discharge, and in some cases to bear slight resentment against the institution.

Affective Psychoses.

It may be said at once that no doubt exists as to the efficacy of convulsion treatment in affective psychoses; in fact it has claims to be little less than a specific. Early results were published by Verstraeten (1937), followed by Serko (1938) in Germany, Low *et al.* (1938) in U.S.A., and Cook and Ogden (1938) in England. Later conclusions have confirmed the early favourable reports.

As regards psychotic depressions as a whole, Müller (1939) (collected results) showed 58 per cent. recovered and 13 per cent. unimproved in 148 cases, Bennett (1941) 53 per cent. recovered and another 44 per cent. socially remitted and only 4 per cent. not improved in 146 cases, Furst and Stouffer (1942) 75 per cent. discharged with or without insight and 11 per cent. unimproved out of 65 cases, Osgood (1942) 83·5 per cent. discharged recovered or greatly improved and 5·5 per cent. unimproved out of 91 cases, and Fitzgerald (1943) 78 per cent. recovered and 4·7 per cent. not improved out of 150 cases. Perhaps

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the most noteworthy feature is the small number of unimproved cases, a collection of 690 cases yielding only 50 (just over 7 per cent.). Among a wealth of references only three are unfavourable; Kwalwasser (1940) found no remissions in 5 depressive cases, Kepner (1941) had scant success in treating 24 depressives in Hawaii, and Read *et al.* (1939) reported discouraging results in 8 involutional melancholics.

There is widespread agreement that duration of illness plays a far less important prognostic role in affective psychoses than in schizophrenia (Low *et al.*, 1938; Mader, 1938; Cottington, 1939; Cummins, 1940; Corwin and Voth, 1941). Osgood (1942) obtained 57 recoveries or great improvements out of 63 depressives under one year's duration, and 9 out of 13 over two years. Fitzgerald (1943) obtained 76 recoveries out of 89 depressives under one year, 13 out of 17 between two and three years, and 9 out of 20 over three years. He concludes that duration of illness does not influence results provided it is under three years. Sogliani (1939*a*) obtained 81 per cent. remissions in mainly chronic cases not improved by other means, and Corwin and Voth (1941) 50 per cent. remissions in cases ill over one year. This is of the utmost importance when one considers the large numbers of chronic melancholics to be seen in every mental hospital.

The presence of anxiety (Mader, 1938; R. H. and G. A. Young, 1939; Osgood, 1942), of compulsion features (Mader, 1938), or of schizophrenic features (R. H. and G. A. Young, 1939) in a depressive setting is said to be unfavourable.

Involutional depressive states, where tabulated separately, show results similar to "manic-depressive" or undifferentiated depressions, a collection from six sources showing 52 per cent. recovered, 20 per cent. incomplete remissions, and 10·5 per cent. unimproved. The commonly accepted spontaneous remission-rate for involutional depressions is 20–40 per cent. The rather higher "unimproved" rate in involutional states, compared with depressions as a whole, is not surprising considering the greater tendency to underlying vascular brain lesions in the higher age-groups. Osgood (1942), analysing five disappointing cases, suggests that all therapeutic failures may possibly be due to the presence of irreversible organic brain lesions. Good results are obtained in cases of three and four years' duration (Sogliani, 1939*b*).

Convulsion therapy has without doubt proved a boon in involutional melancholic states. Smith *et al.* (1942), who consider it should be reserved for such states, observe that the recovery of long-standing agitated depressions makes a profound impression, while others (Mader, 1938; Bennett, 1939) obtained their best results in climacteric and presenile depressions. Palmer *et al.* (1941), treating 27 involutional melancholics with cardiazol fits, 12 by prolonged narcosis, and 36 with endocrine extracts, found definitely superior results from convulsions.

Separate figures for manic phases are not often given and I can collect only 56 cases suitable for tabulating. These show 46 per cent. recoveries, 34 per cent. social or other remissions, and 12·5 per cent. unimproved. General opinion is definitely favourable, and suggests that the treatment prognosis in mania is only slightly less good than in depression. Cronick *et al.* (1940) believe

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that in the very early stages of a manic attack there is a refractory period to fits; after this, fits evoke a quick response, but relapse follows cessation of treatment. Later, after the period of potential mania has spent itself, the attack may be rapidly ended with a few fits; depression on the other hand tends to show a gradual lysis.

Adequate courses and tendency to relapse.—In assessing the value of convulsive therapy in affective states the question of relapse is important. With too few fits there is the same likelihood of relapse within a few weeks as in schizophrenia, but this usually clears up rapidly with a few further convulsions. E., E. S-., and L. Ziskind (1942), in stressing the importance of giving a sufficient number of convulsions, state that out of 21 patients receiving adequate therapy all had persisting full remissions, while of 17 receiving inadequate therapy 11 relapsed. Zeifert (1941) found no relapses in 18 patients who recovered sufficiently to leave hospital, but Fitzgerald (1943) reported 12 relapses in 135 discharged depressives. In neither case did the time factor appear to be sufficient to class these relapses as fresh attacks. Temporary hypomanic swings after treatment of depressions are not uncommon (Osgood, 1942).

Hospitalization is undoubtedly reduced (Smith *et al.*, 1942; E., E. S-. and L. Ziskind, 1942). Shelton (1942) observed the startling difference of 6 weeks for convulsion treated as against 63 weeks for spontaneously remitting affective states. E., E. S-. and L. Ziskind (1942) found an average reduction of 4½ months. The same authors, in an interesting study of 38 cardiazol treated and 47 untreated affective states, obtained 82 per cent. full remissions in the treated group and 38 per cent. full remissions in the untreated group. Only 5 per cent. of the treated group were unimproved, as against 17 per cent. of the untreated group. These figures are all the more convincing, because 22 of the 47 untreated patients did not have treatment solely because their symptoms were too mild to warrant it, the remaining 25 either refusing treatment or being physically unfit. Among the treated group one committed suicide during a relapse after remission; of the untreated cases three committed suicide, and two died of exhaustion.

Psychoneuroses.

Published results of convulsion treatment of neuroses are scanty, and for the most part confined to a few cases. Good (1941), treating 40 war psychoneurotics who did not, or were judged unlikely to respond to ordinary psychotherapy, was not optimistic as to their ultimate prognosis, although 11 were able to return to military duty of some kind, and all but one improved in varying measure. Cheney *et al.* (1941*b*) obtained four recoveries and three great improvements in eight psychoneurotics, Zeifert (1941) two recoveries in three cases, and Low *et al.* (1938) three recoveries in three cases. Furst and Stouffer (1941), treating five cases of anxiety state, obtained four remissions with insight and one improvement. Shapiro and Freeman (1939) also reported good results. Pacella and Barrera (1943), however, found their results rather discouraging. Despite some successes, consideration of the fundamental make-up of psychoneurotic states renders it highly improbable that the underlying psychoneurotic personality will be influenced or that

remissions will be lasting. The views, already mentioned, that anxiety or compulsion features in a depressive setting are unfavourable, indicate the general trend of opinion. It is possible that much of the success reported in treating psychoneurotics with convulsions consists in clearing up essentially depressive symptoms, which may often simulate neurotic anxiety.

Some acute hysterical manifestations may clear up with a few convulsions (Ingalls, 1939), just as they may react to any form of severe shock, but permanent cure is not as a rule to be expected.

Other Conditions.

Few mental disturbances have not been subjected to convulsion treatment. Kenyon *et al.* (1941) reported encouraging results of convulsion therapy on the psychotic symptoms of GPI, but it is noteworthy that the cases were mainly of the florid, emotional type and that improvement was purely symptomatic.

Avery and Campbell (1941) treated ten morphia addicts with daily cardiazol fits. Rapid reduction of morphine without withdrawal symptoms was made possible, but cure is not claimed.

To Owensby (1940) falls the distinction of making the most dramatic of reports. He claims to have treated one female and five male cases of confirmed and long-standing homosexuality with such success that after 6 to 15 fits all six patients lost their homosexual urges and acquired lasting heterosexual desires.

CONCLUSIONS.

Whatever the ultimate fate of convulsion therapy may be, there is little doubt of its increasing popularity. In this connection Kolb and Vogel's analysis (1942) of replies to a questionnaire sent to 356 hospitals in U.S.A. and Canada is of great interest. Replies were received from 305 hospitals, covering a total of 23,651 patients who had been treated with insulin in the years 1935–41 inclusive, and 44,608 patients who had been treated by metrazol or electric convulsions in the years 1936–41 inclusive. Graphs show that the number of hospitals using insulin reached its peak (54 per cent.) in 1938. In 1941 the figure had dropped to 47 per cent. Metrazol reached its peak of 65 per cent. in 1939 and is now falling with the rapid rise of ECT, which in 1940 was used in only 10 per cent. hospitals as against 42 per cent. in 1941. The use of insulin appeared to be declining mainly because of the cost and difficulties of administration as compared with convulsion treatment. Of 111 hospitals which had used all three methods, nearly 60 per cent. preferred ECT, 8 per cent. metrazol, 13 per cent. insulin, 7 per cent. some combination, and 13 per cent. were undecided or did not state. Of the hospitals employing insulin 96 per cent. used it for schizophrenia, 25 per cent. for manic-depressive states and 14 per cent. for involutional melancholia; of those employing metrazol 81 per cent. used it for schizophrenia, 73 per cent. for manic-depressive states, and 67 per cent. for involutional melancholia; of those employing ECT 79 per cent. used it for schizophrenia, 86 per cent. for manic-depressive states, and 73 per cent. for involutional melancholia. General opinion was overwhelmingly in favour

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of convulsion therapy in affective states, but doubtful as regards schizophrenia, for which insulin was regarded as more effective.

To sum up it may be said that in schizophrenia the position of convulsion treatment remains controversial. It appears to have a definite curative value in recent cases, with clear-cut onset, particularly when affect remains lively. In longer standing cases its benefits are mainly symptomatic. States of stupor and refusal of food can nearly always be relieved and faulty habits often corrected, albeit transiently. Maintenance courses of weekly treatments are sometimes helpful. Relapses are to be expected if treatment is stopped before full remission has been achieved.

In affective states the value of convulsion therapy is not open to doubt. Even in those cases which would eventually recover spontaneously convulsions cut short the acute symptoms, and with them the dangers of self-injury and exhaustion, the nursing difficulties and the period of hospitalization.

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INSULIN THERAPY.

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SINCE Sakel (1) introduced treatment by insulin a vast literature has emerged from all countries. This was admirably reviewed by Wilson and Rees-Thomas (2) in 1938, so that consideration is given here to publicalions since that date. Even so, it has not been possible to incorporate all the publications, but a sufficient number has been drawn upon to present the essential position as it is to-day. Whatever may be the final judgment on the efficacy of insulin therapy, there is no doubt that its introduction has been an enormous stimulus to therapeutic endeavours. Its main interest has been to the psychiatrist, but the problems presented have attracted the attention and interest of workers in other branches of medicine. Ebaugh (3) has summarized this interest thus: "The physiologist has become interested in the mechanism which produces the coma; the biochemist is interested in studying the various chemical changes which take place during therapy; the neuropathologist is concerned with the pathologic changes that occur during and after the therapy; the internist is concerned with the problem of 'punishment' that the body is forced to absorb during the actual treatment; the psychologist is absorbed in following the psychological changes which take place under the influence of the treatment; the orthopaedist desires to know the type of fractures occurring during insulin, electrical and metrazol therapy; the neurologist studies the influence of these therapies upon the organic nervous system; and the psychiatrist attempts to explain the manner in which the psychosis is altered."

A relatively brief review of the literature, such as this purports to be, is facilitated by a classification of the different aspects of the treatment. Various contributions will be considered, therefore, in so far as they relate to—

(1) Modifications of the method of administration and general management.
(2) Frequency, type and treatment of complications.
(3) Results of treatment; prognostic factors.
(4) Psychological, biochemical and histopathological aspects.
(5) Conclusions.

MODIFICATIONS OF THE METHOD OF ADMINISTRATION AND GENERAL MANAGEMENT.

In the ten years which have now elapsed since the introduction of insulin therapy much experience has been gained. Problems remain unsolved, but it is now possible to evaluate more clearly the possibilities and advantages of the method. In the light of this additional experience many modifications have been made in the technique. Sakel (4) in 1938 recommended modifications of his original method, and various other workers have elaborated their own

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variations, several of which merit consideration. In an attempt to avoid the severe symptoms Beno (5) suggested a modification whereby the same dose of insulin was administered on successive days. The actual dosage remained small, so that deep coma was not produced. Sargant and Craske (6) gave doses which were described as being just insufficient to produce a slight coma or hypoglycaemic excitement. They aimed at producing a state of drowsiness, and the patient was awakened by the administration of glucose if even a slight coma was suggested. Tomlinson and Ozarin (7) reported favourable results from a similar method in which they employed an average dose of 5 to 50 units of insulin. They experienced only 4 convulsions in over 4,000 treatments and there were no contra-indications to the method. Benefit has been claimed, and is readily possible in the treatment of minor symptoms. If, however, the symptoms are of a psychotic and severe nature then the use of such methods seems doubtful, unless there is some other contra-indication to intensive treatment.

One of the major problems, which has been aggravated by war conditions, is the length of time involved for the course of treatment and the necessity for a large trained staff to be available. It is not surprising to find, therefore, that numerous efforts have been made to modify the technique so that the period of time should be shortened and the degree of nursing supervision reduced. With this end in view insulin has been introduced intravenously instead of intramuscularly, it being hoped that a saving of insulin would result as well as the time involved in treatment. Jones (8) reported that the same amount of insulin was required intravenously as by the intramuscular route, but that coma was produced more rapidly. One patient who was coma-resistant remained so to intravenous insulin. Similar results were reported by Sherman, Mergener and Low (9), and Goldfarb (10). Polatin, Spotnitz and Weisel (11) favour this method of administration. They found that a smaller dose of insulin was necessary to produce coma and that this developed more rapidly. They also reported quite frequent spontaneous recoveries from coma, so that the patient could then drink the solution of sugar. They were of the opinion that the degree of nursing supervision was lessened. Sandison and McGregor (12), after an extensive period of observation, reported that by this method of injection a saving of insulin amounting to 28 per cent. was obtained. They found also that hypoglycaemia occurred earlier and was more profound, and that recovery after termination was more rapid. They were of the opinion that insulin produced its beneficial effect by a stimulation of the nerve centres controlling the autonomic system. Studies of the flow of gastric juice suggested to them that intravenous insulin was a more powerful autonomic stimulant than intramuscular insulin. Mahoney and Herskovitz (13) reported on urticarial complications following intravenous injections, and they advocated giving initial small doses of insulin subcutaneously to determine the degree of sensitivity to the drug. They reported furthermore that there was a tendency to develop secondary coma in spite of an adequate glucose intake. Peterson and Lutz (14) have employed this method of administration as being more likely to induce convulsions during coma.

Various modifications in the type of insulin have been used. Protamine zinc

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insulin has been tried because of its prolonged action in depressing the blood sugar. Neither Goldman (15) nor Sandison and McGregor (12) were impressed by the efficacy of this method. The latter were of opinion that there was no particular danger involved in giving this drug intravenously, and they found no apparent advantage from a combination of protamine zinc with ordinary insulin. The consensus of opinion is against the use of this drug, and Reese and Van der Veer (16) have summarized the objections: (*a*) The effect of equal doses is not the same, and the dose must therefore be constantly varied, as no uniform treatment dose can be established; (*b*) closer co-operation with the laboratory is necessary; (*c*) the danger of after-shock is greater, and (*d*) epileptiform attacks are more frequent. Polatin (17), while agreeing that there was no therapeutic advantage over ordinary insulin, suggested that it might be beneficial if the latter produced allergic symptoms. Goldfarb (18) and Kant, Phillips and Stolzheise (19) have recommended that the administration of insulin in small divided doses was more effective in lowering the blood sugar. The latter suggested that the total dose of insulin be divided and the second half be given one hour after the first. They claimed that the amount of insulin necessary to produce hypoglycaemic coma was reduced and the number of days before the initial coma developed was also shortened.

There are differences of opinion as to the duration of treatment, particularly as to the number of comas which should be given. The general opinion is that if improvement is to be achieved, evidence of this will be apparent relatively early in treatment, and no advantage will be gained by more than 60 comas. Polatin and Spotnitz (20), however, have carried out this method over prolonged periods. They aimed at producing a mild hypoglycaemic state characterized by weakness, excessive perspiration and drowsiness. They have reported that one of their patients had received such treatment over a period of 2½ years; marked clinical improvement was claimed, and they were of the opinion that the beneficial effects were cumulative. Protracted comas which lasted from 3 to 15 hours, with a subsequent state of stupor of from 7 to 72 hours, have been advocated by Billig and Sullivan (21) in those cases of schizophrenia where a satisfactory psychiatric improvement did not occur, or when previous shock therapy had been unsuccessful. They recommended the administration of thiamine hydrochloride and novaldine according to the severity of the symptoms.

The dosage of insulin depends on two factors: (*a*) the sensitivity of the patient, and (*b*) the degree of coma which the physician desires to produce; but neither of these factors alters the sequence of the symptoms.

Considerable variations have been experienced in the reaction of patients to insulin, and it is generally agreed that there is a marked individual sensitivity to the drug. Success in the induction of coma has been reported with doses of 15 units by James, Freudenberg and Cannon (22), and of 18 units by Parfitt (23); others have reported failures after the injection of enormous doses of insulin. Banting (24) was unsuccessful in one case after the administration of 1,000 units, and we have had a similar experience. The consensus of opinion is in favour of a gradual increase from the initial dose of 10 to 15 units. Reese and Sauthoff (25) have advocated giving an initial dose of 60 units so as to shorten the pre-

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paratory phase and increasing the dose daily by 10 to 30 units. The chief criticism of this, however, is the increased degree of risk. To avoid the use of very large doses of insulin in overcoming resistance in insensitive patients von Braunmühl (26) has developed his zigzag method. In this he has recommended alternation on successive days of the maximum and the minimum dose, and on the third day the administration of either half the maximum (delayed alternation) or the maximum dose (direct alternation). Variations of this have been elaborated and facilitate the development of coma on a lower dosage than was formerly required.

The second phase should be reached in the third hour and the patient should lose consciousness. Unless it is desired to produce some particular reaction on the part of the patient, the majority of physicians do not further increase the dose of insulin after the coma stage has been maintained. It cannot be stressed too strongly that the only safe method of assessment as to the dosage is by detailed observation of the development of the clinical picture. Considerable help will be obtained from a study of the tables which have been produced by Frostig (27) and by Ross and Malzberg (28). These tabulate the list of symptoms which may be expected and show their time relationship. Frostig (27) states that the efficiency of the same insulin dose increases from the 1st day of treatment until the 12th to 26th day. A decrease of efficiency is then observed, and another climax of sensitization occurs when the second part of the treatment is reached. In choosing the daily dose to be administered it is necessary to consider (*a*) the individual susceptibility, (*b*) the depth of the preceding coma, and (*c*) the actual change in the patient's sensitization. The progression of the symptoms makes it possible to use them as gauges of the depth of the coma. He divides the reaction into four stages: (1) the cortical phase, (2) the basal ganglial phase, (3) the midbrain phase, and (4) the medullary phase. He defines the absolute time limit as five hours, beyond which treatment should not be extended—though obviously it might have to be terminated earlier. The time at which the medullary phase is reached is dependent to a certain extent on the dose. Large doses may achieve this in three hours, whereas smaller may not achieve the same reaction for six to seven hours. He recommends that the dose employed should be such that the medullary symptoms appear in the last half of the fifth hour. He is of the opinion that the shock seems to be therapeutically adequate if the tonic phase persists for one hour, but his results suggest that this may be more applicable in recent cases. Rossman and Cline (29) favour the induction and prolongation of deep coma in more chronic types of illness. Obviously such a method carries with it a greater degree of risk and necessitates considerable experience.

The termination of the treatment is by the administration of sugar. Most physicians favour the original method by nasal feed except when any dangerous situation develops. Benefit has been achieved by ensuring that the solution of glucose is well diluted and warmed before being passed into the stomach, as recommended by Hunt and Feldman (30). The rate of absorption is thereby increased. Sometimes an intensification of the symptoms of hypoglycaemia has been seen after the administration of glucose, and this is considered to be due to an increased bodily flow of insulin as the result of stimulation by sugar.

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The practical point of this is that it is expedient to keep the patient under observation in bed for at least 30 minutes after feeding. In an effort to conserve sugar Sandison and McGregor (31) report their results from a feed in which sugar is replaced to a large extent by potato. Others who have used this method have not been so impressed by this variation, and have found the frequency of secondary comas to be increased. McGregor and Sandison (31) recommend termination of the coma by intravenous administration of glucose, and within a short period of time the patient should recover sufficiently to drink the potato soup. Many others recommend termination by the intravenous method as a routine procedure, among whom are Olsen (32), Leulier, Le Clercq, Casalis and Capelle (33). This method of termination should always be augmented by additional oral administration of carbohydrates.

Frequency, Type and Treatment of Complications.

Like many other forms of treatment the application of insulin therapy is not without risk; in fact in inexperienced hands the method is definitely dangerous. Isolated instances of complications have been recorded and will be referred to briefly. Freed and Wofford (34) reported a case of sub-arachnoid haemorrhage during insulin therapy, and refer to reports of various types of haemorrhage during treatment. They suggest that there exists a relationship between hypoglycaemia and haemorrhage into various organs. They consider that this is due to damage to the walls of the capillaries by anoxaemia, resulting in an increasing permeability. Pulmonary complications, including broncho-pneumonia, lung abscess and pulmonary oedema have been reported frequently. O'Neil (35) refers to pulmonary oedema as occurring in cardiac failure or as evidence of cardiac insufficiency; its onset may be most alarming. These complications will be referred to later as causes of death. Hinko, Fenton and Balberor (36) draw attention to the occurrence of allergic symptoms. They point out that sensitivity to insulin during treatment may not be limited to a decrease in tolerance and local reactions, but may suddenly show itself as an anaphylactic reaction and demand immediate and appropriate treatment.

Everybody is agreed that the prolonged coma is by far the most serious of the complications that may develop. If the patient does not wake up within 30 minutes after receiving the glucose feed, then intravenous glucose should be given. In most cases recovery of consciousness is rapid, but occasionally no response is obtained; coma becomes prolonged and may persist for hours, days or weeks. Fever, rapid pulse rate, increased respiration and vomiting are common accompaniments, and death may result, often through pulmonary complications. Sherrill (37) has shown that if animals are left too long in coma the administration of glucose will not revive them and they will die. Lester (38) studied 25 cases of prolonged coma and found the mortality-rate in this series to be 16 per cent., while the death-rate due to this complication in the total insulin therapies reported was 0·33 per cent. He was of the opinion that prolonged coma might be expected once in every 1,877 treatments.

An enormous amount of research work has been done in an effort to obtain an understanding of the mechanisms involved and to elaborate a satisfactory method of treatment. The large number of therapeutic methods suggested,

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together with the conflicting views on their efficacy, merely illustrate our inadequate knowledge at the present time. Lumbar puncture was recommended in the earlier stages; now many believe it to be of no benefit. Vitamin B_1 administration has been advocated by Freudenberg (39), Finiefs (40), Fraser and Sargant (41), Muller (42), and by Frostig and his co-workers (43), whereas Gillman and Parfitt (44), Goldman (45), and Cleckley and Templeton (46) have found no benefit from its administration. Adrenaline was recommended by Reese and Van der Veer (16) and by Fraser and Sargant (41), but is now generally accepted as of doubtful value and by some as definitely contra-indicated. Venesection was recommended by Frostig (47), whereas blood transfusion has been advocated by James (22) and his co-workers, Wortis and Lambert (48), Menzies (49), and Procter and Easton (50). The administration of calcium has been advocated by von Braunmühl (51), Finiefs (40), and Fraser and Sargant (41), but little benefit was obtained by Gillman and Parfitt (44) and by Muller (42).

Irreversible coma often develops in the early stages, and Muller (42) is of the opinion that it is avoidable and is due, as a rule, to deficiency in technique. Further administration of glucose by the stomach is valueless. In most cases this is merely retained and very little is absorbed. Binzley and Anderson (52) stress the fact that the reaction continues in the presence of normal or high blood sugar, which is generally agreed. Finkleman (53) is of the opinion that irreversible coma develops in those patients in whom the blood sugar rises to hyperglycaemic levels, but the brain is unable to utilize sugar. He questioned the usefulness of further intravenous glucose unless the blood sugar has been estimated and a low level found. Freudenberg (39) drew attention to the fact that the large doses of glucose given increased the ratio of carbohydrates to the other food metabolized, and to rectify this suggested the administration of vitamin B_1 as stated above. Cleckley and Templeton (46) considered that there was a marked deficiency in oxidation, and consequently advised giving riboflavin and nicotinic acid.

Patients who recover from a state of irreversible coma, not infrequently show definite mental improvement. This has been commented on by, among others, Easton (54) and Rossman, Murray and Cline (55), and because of this improvement Kraulis (56) at one time advocated that one should attempt to produce this reaction. Kant (57) disagreed with this because of the mortality rate, and also the danger of producing permanent organic brain damage. Frostig (58) considered that the danger to life, the possible damage to the brain, and the clinical results made the risks in the induction of protracted coma too great. Its therapeutic use could not be justified unless we were able to predict and control it. In our present stage of knowledge this cannot be done. Frostig (58) was of the opinion that there was no likelihood of protracted coma if treatment was terminated at or shortly after the beginning of the medullary phase. He suggested that the prolonged effects of insulin on the nuclei of the medulla resulted, initially, in suppression, and finally in paresis of their functions. Suppression of these would obviously lead to suppression of the mechanism for the assimilation of carbohydrates. To avoid this complication he suggested (*a*) termination as soon as signs of medullary involvement appeared; (*b*) if, because of the severity of the mental picture, more in-

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tensive treatment was necessary, then coma should be terminated, initially, by the intravenous method; (*c*) patients who showed a tendency to protracted coma should receive the regular administration of vitamin B_1.

The occurrence of epileptiform seizures has attracted considerable attention. They were considered in Sakel's (59) earlier writings, when he described two forms of hypoglycaemic coma—wet and dry; in the latter, convulsive attacks might occur during the third hour of hypoglycaemia. Frostig, Bennett, Schreiber and Thomas (60) have shown that there is no correlation between the degree of perspiration and the insulin convulsion. In a series of cases the percentage of shock without perspiration for the comatose type was 11·2 and for the convulsive type 14·7. As to the frequency of such convulsions Goldman (61) found the incidence to be 3·9 per cent., Frostig (60) 4·2 per cent. Goldman (61) was of the opinion that they were a characteristic of the patient rather than of the method, and that they were evidence of specific and probable individual irritability of the cerebral cortex to hypoglycaemia. There was some evidence that those patients were more susceptible to convulsive attacks whose mental symptoms were of long duration.

It is now recognized that there are two varieties of convulsion—early and late. The former occurs within 45 to 100 minutes after the injection, the latter in the fourth hour. Von Braunmühl (26) considered convulsions to be of the late variety if they occurred after the second hour. Frostig (60) and his co-workers have pointed out that the types of convulsions are not identical; those due to insulin consist of forceful lightning-like jerks, which they refer to as myoclonoid. They drew attention to the accompanying degree of vascular collapse which follows the twitching, even though all the myoclonoid twitchings are not necessarily followed by a seizure. The danger depends on the time of the occurrence of the seizure; the early variety are much less serious than the late. Many considered the early seizure of therapeutic value, but Schulz, Heilbrunn and Sternleib (62), Goldman (61) and Muller (42) disagreed with this opinion. Malzberg (63) reported that the recovery rate in the New York Hospitals was not increased in those patients who had convulsions, and thus threw doubt on the generally accepted belief that convulsions were beneficial. Late seizures, on the other hand, are to be regarded as dangerous, and as an indication to shorten the duration of coma or to reduce the dose. Muller (42) recommended in such cases the administration of luminal in 2- to 3-gr. doses early in the morning; and Frostig (60) has attempted to control the incidence of convulsions by intravenous injections of sodium amytal in doses of 1½ to 2 gr. in the myoclonic prodromal phase. The injections might be repeated if the twitchings should reappear. Compression fractures of the spine have been reported in 20 per cent. of those patients who develop convulsions during treatment by insulin. Various techniques have been elaborated to prevent the incidence of fracture, consideration of which will be found in the chapter on convulsive therapy.

Results of Treatment; Prognostic Factors.

A comparison of the results of treatment as published by different investigators is always difficult. This is due to the selection of cases, the tech-

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nique adopted and the evaluation of the clinical condition after treatment, in all of which there might be wide variations. Each new treatment for schizophrenia has found those readily optimistic, counter-balanced by others more guarded. Now that results are available in a fairly large group of cases, a better assessment may be made of the advantages and disadvantages of this method of treatment.

It is interesting to recall at this stage the previous results of schizophrenics treated by ordinary conservative methods. Stalker (64), in his follow-up study, has tabulated previous similar statistical studies by other physicians since the end of the last war. In his own series of 129 cases, treated between 1932 and 1937, which he was able to trace, 12 per cent. had a complete remission, 8 per cent. a social remission, 9 per cent. were improved, 21 per cent. had relapses and 50 per cent. were not improved. Guttmann, Mayer-Gross and Slater (65) followed up a series of 188 schizophrenics three years after discharge from hospital; initially all had been considered to be of good prognosis. They found that over 33 per cent. had remained well, 41 per cent. were in mental hospitals and over 50 per cent. were invalids at home or in hospital. In an early contribution Sakel (66) claimed 70 per cent. of full remissions among his recent cases treated by insulin. Of the others under treatment, the duration of whose symptoms was over six months, it was found that the result varied in direct relation to the duration of the illness. The results of 1,039 cases treated in the New York Hospitals were reviewed by Malzberg (63) in 1938, and these were compared with the control group of a similar number. In the treated group there were 12·9 per cent. reported as recovered and 27·1 per cent. as much improved. The corresponding figures in the control group were 3·5 per cent. and 11·2 per cent. If one included all degrees of improvement, the corresponding figures were: treated 65 per cent., controls 22 per cent. Ross, Rossman, Cline, Schwoern and Malzberg (67) reviewed this same treated group two years after treatment and found that 12·7 per cent. were considered recovered and 14·2 per cent. much improved. When one included all degrees of improvement the number fell from 65 per cent. to 45·4 per cent. They concluded that the condition of these schizophrenic patients treated with insulin had become practically stabilized with respect to the possibility of further deterioration and approximately 45 per cent. showed some degree of lasting improvement. The recovery-rate remained practically constant. As regards clinical types, the rate of improvement was higher in catatonics and paranoids than hebephrenics.

Bond and Rivers (68) have made a similar review of cases followed over a number of years after treatment. Their series has the advantage that all the patients were treated in one hospital by a group of psychiatrists with the same standards of diagnosis and evaluation of results. The immediate results in 188 patients showed improvement in 55 per cent., which fell off to a level of 33 per cent. in the second, third and fourth years. The immediate recovery-rate was five times that of control cases and the distant recovery-rate twice that of controls. They report an interesting observation. Between 1936 and 1938, 82 patients were treated by different physicians; the aim was to maintain hypoglycaemic stupor with the minimum dose necessary. When this was

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reached a reduction in dosage was made if the coma level could be maintained. Convulsions were regarded as evidence of over-dosage. In 1939–40, 72 patients were treated by one physician. The coma dose was not considered the optimum; deeper and longer stupor was achieved by increasing the dosage, and convulsions were not regarded as a contra-indication to increasing the dose of insulin. Of those treated by the method employed in 1936–38, 44 per cent. were improved at the conclusion of treatment, whereas by the method in 1939–40 the corresponding figure was 63 per cent. The respective figures at the end of 12 months after treatment showed that 34 per cent. of the 1938 group had remained improved and 57 per cent. of the 1940 group.

Menzies (49) reported his findings in 118 patients after treatment. Of these, 85 were able to leave hospital; 12 subsequently relapsed, but 50 per cent. of these made a satisfactory improvement after further treatment. He advocated the use of a standard diet by means of which he had been able to reduce by 30 per cent. the amount of insulin necessary to produce coma. Prolonged treatment he regarded as essential, and did not despair even if improvement had not been achieved after 140 comas.

An analysis of 50 patients treated by Cheney and Clow (69) showed that at the end of treatment by insulin 48 per cent. had improved. A follow-up study at the end of six months to 2½ years after treatment revealed that the number in the improved group had fallen to 36 per cent.

Not all investigators are impressed with the value of this method. Libertson (70) found an initial improvement-rate of 62 per cent. in 165 patients so treated, but that this rate subsequently levelled down to 40 per cent., and corresponded closely to the results achieved in a control group. He concluded that considerable doubt was felt at the Rochester Hospital as to the value of the method. Similarly Gottleib and Huston (71) formed the opinion that insulin therapy given to a group of 66 schizophrenics did not increase the remission-rate over that obtained from more conservative methods. In both their insulin-treated and their control group 44 per cent. of those whose symptoms had been present for less than six months made a complete or social recovery. The method of treatment adopted was that insulin was decreased after coma levels were reached, and they considered that difference in the technique of insulin treatment might yield different rates of remission.

The majority of the results reported are in support of the method, and sufficient evidence is now available to make the following deductions: (*a*) Insulin does materially alter the clinical picture in schizophrenia even up to the complete abolition of symptoms. (*b*) The increased rate of improvement reported in acute cases ranges from 1·5 to 3 times that of ordinary hospital methods. (*c*) Those who respond to the treatment do so in a relatively short time, and the method, therefore, appreciably shortens the course of the illness. (*d*) Apart from those who recover, many others show a marked temporary improvement which they appear unable to maintain. The necessity for further work to determine the nature of this reaction is apparent. (*e*) While the immediate results are higher than in controls, as times goes on the discrepancy, though still apparent, becomes less marked. (*f*) Insulin therapy remains only a method of treatment. Its application is much more effective if combined

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with all other therapeutic facilities, re-educational, psychological, occupational, etc.

With regard to the incidence of relapses various findings have already been enumerated. In those patients whose symptoms had existed for longer than twelve months before treatment Muller (42) found that symptoms recurred in 6·5 per cent.; if the symptoms had existed longer than twelve months relapses developed in 13 per cent. Horwitz, Blalock and Harris (72) collected reports from the literature on 262 cases. They found that 22, or 8·4 per cent., had relapses. Of their own cases 25 per cent. relapsed within twelve months. A high proportion of these patients showed improvement with further treatment.

It is difficult to obtain a true mortality-rate from the small group of patients reported by individual physicians. Bond (68) reported that three patients died in a series of 188. Muller (42) recorded the mortality-rate as 0·5 per cent. in 500 cases. Malzberg (63) in a series of 1,039 cases reported that there were 13 deaths—1·25 per cent. A more recent analysis has been made by Kinsey (73), who circularized a questionnaire throughout a large number of hospitals. He obtained particulars of 12,234 patients, and of these there were 90 deaths associated with the treatment—0·73 per cent. There was a relatively high incidence due to cerebral causes, of which there were 50, 38 being the result of prolonged coma. Twenty-two deaths resulted from pulmonary causes, of which pneumonia accounted for 16. There were 12 deaths from cardiac complications, and the others were included in the miscellaneous group. James (74) and his co-workers in 1937 expressed the opinion that the death-rate would always prove to be in inverse ratio to the care with which a proved technique was adopted and applied. It is reasonable to assume that further reductions in this mortality-rate will yet be made.

Prognostic Factors.

Numerous reports are available as to the favourable prognostic factors in patients treated by ordinary hospital methods. Stalker (64) in the review already referred to found that the favourable factors were (*a*) healthy habits of reaction, (*b*) preponderance of non-constitutional factors, (*c*) acute recent onset, (*d*) well retained affective response, (*e*) acute types of illness which could not be fitted into the four standard sub-groups. It will be readily appreciated from the following opinions that the same factors hold good in cases treated by more active methods.

Practically all are agreed that the main prognostic factor is the duration of symptoms prior to treatment. The type of personality and the circumstances surrounding the onset of the illness was stressed by Ross and Malzberg (28) as next in importance. Menzies (49), however, considered that of greater importance was the fact whether or not the patient had attained satisfaction in his unreal world. If he was still unsuccessful in attaining a satisfactory world of phantasy and delusion he was worth treating, and he suggested that this was the reason why paranoid types responded better than others, in that they were still unsatisfied with the world of phantasy which they had created. Freudenberg (75) reviewed his results in 72 patients with particular reference to the prognostic factors. The favourable factors were (*a*) acute

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onset, (*b*) short duration of illness, (*c*) pyknic or athletic build, (*d*) cyclothymic temperament, (*e*) tendency to remission. In estimating the prognosis he advocated the consideration of all the factors at the one time; if three or more unfavourable factors were present the prognosis was increasingly serious. Cheney and Clowe (69) expressed the opinion that the best outlook for recovery or improvement was in males under 30 who had had an adequate prepsychotic personality, were suffering from a psychosis with an abrupt onset and a definite external precipitating cause. They had been ill for less than a year before treatment, and the mental picture was that of an excited catatonic state without evidence of deterioration. It is obvious, therefore, that the prognostic factors in schizophrenia are the same, irrespective of the method of treatment.

With regard to the influence of age, Freudenberg (75) considered this to have no decisive influence on the outcome. Ross and Malzberg (28) found that those over 25 years of age responded better than those under. The older group had made a better emotional adjustment, and in most cases there were definite precipitating factors.

An important prognostic factor during treatment is the effect on bodily weight, the consensus of opinion being that clinical improvement is always accompanied by a gain in weight. Von Braunmühl (76) has described four types, classifying each according to the bodily response. Both Muller (42) and Plattner (77) reported that they had never seen clinical improvement associated with loss of weight.

Most of the work in insulin therapy has been carried out in the treatment of schizophrenia. It has been found that of acute cases the paranoid offer a better prognosis than the catatonics, but in the hebephrenics and the simple varieties the outlook is relatively poor. Of the more chronic types of illness the catatonic variety appears to respond better than the paranoid. Skottowe (78) has drawn attention to a group of patients—those showing dys-symbole—who have failed to react to any known form of treatment; all of us have had similar failures. He was of the opinion that it was a waste of time to treat this type of patient, but sufficient evidence is not available in support of this. Most physicians report a better prognosis in atypical cases. This immediately raises the question of diagnosis, especially in the early stages of the illness, and the probable inclusion, by some, of clinical types which would not be readily accepted by others as schizophrenic. As regards the use of insulin in the treatment of other syndromes, success has been claimed in the treatment of manic excitement and also involutional melancholia. Endogenous depressions do not respond favourably to this method. It is recommended also in the treatment of obsessional neurosis—Freudenberg, etc. (75)—and reference has been made earlier to its employment in smaller doses in other types of neuroses. More recently psychological and encephalographic examinations have suggested that they may be of prognostic value; these will be discussed later.

Psychological, Biochemical and Histopathological Aspects.

Psychological investigations.—Various psychological studies have been made with a view to throwing greater light on certain clinical phenomena associated with the treatment and also their use as a prognostic aid. Orenstein and

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Schilder (79) devoted special attention to a study of Gestalt functions, both during and after treatment. At the same time the attitude of the patients towards their symptoms while under insulin treatment was considered. They found a general retardation in reaction. Difficulty was experienced by the patients during treatment in general perception, and a difficulty in naming objects was particularly noticeable. There was a marked degree of perseveration noted and visuomotor Gestalt patterns were of a primitive type. They also noted the occurrence of what they described as empty, almost playful excitement, which was considered to be due to the hypoglycaemic state. In some patients quite definite schizophrenic symptoms appeared which might be considered as an activation of the psychosis. Those patients who recovered showed objective insight; they appreciated the fact that they were ill and that their behaviour was abnormal. They lacked any appreciation of the psychodynamics of their reactions, and the investigators had the impression that this was better during the psychotic state. Complete objective insight was lacking in partially improved patients. The improvement resulting from insulin therapy is, therefore, very similar to that seen from spontaneous remissions. Piotrowski (80) investigated how much prognostic help might be achieved from psychological performance tests. He employed the Rorschach method and limited examination to six tests, which he selected for their high predictive value and the ease with which their presence could be determined. These tests were of two groups: (1) pertaining to certain fundamental intellectual traits, and (2) pertaining mainly to the patient's sensitivity and responsiveness to environmental changes. He was of the opinion that the Rorschach method enabled one to distinguish with greater precision than was otherwise possible intellectual regression from emotional regression. The results of his investigation showed that the greater the degree of intellectual regression the smaller the chances of improvement, but the greater the degree of emotional regression the better were the chances of improvement from insulin treatment. Piotrowski (80) found that many unimproved schizophrenics showed Rorschach records resembling organic brain disease. Wechsler, Halpern and Jaros (81) employed five tests, (1) Vocational Interest Blank, (2) Counting by 3's Test, (3) Similarities Test, (4) Directions Test, (5) The Word-meaning Test, in an investigation of 20 schizophrenics before and after treatment, and again before discharge. Of these tests, the first—details of which are given—was most effective. They reported that there was a definite falling-off in the scores by some patients after treatment, and suggested that the therapy might have a detrimental effect so that certain patients had been harmed rather than improved. Halpern (82) also investigated the results of the application of the Rorschach tests, and corroborated the findings of Piotrowski that unimproved schizophrenics showed Rorschach records resembling organic brain disease. He quotes evidence in favour of the view that the Rorschach method is an aid in assessing the likelihood of success in insulin therapy for schizophrenic patients.

In discussing these studies Katzenelbogen (83) considered that apart from their usefulness in predicting the outcome of insulin therapy they suggested either of two possibilities: one is that those patients who respond well to the

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tests and benefit subsequently from treatment belong to a special type in the heterogeneous group of schizophrenics; the other is that success or failure of both test performances and treatment depend closely on the degree to which the mental functioning is impaired by the schizophrenic process.

Biochemical investigations.—An enormous number of laboratory investigations have been made in an effort to correlate the clinical symptoms with the biochemical changes recorded. Georgi (84) and others have shown that the fall in blood sugar is rapid, generally within 30 minutes, that it usually attains its minimum level during the second hour and then rises again. Coma ensued only when the blood sugar had remained at a low level for a considerable time; this period varied in different individuals. It was considered that sugar was withdrawn from the blood stream to the cells of the brain, and that symptoms were dependent in large measure on its concentration, intra- or extra-cellular. Jones (85) failed to get any consistent findings in his attempt to correlate blood-sugar readings with changes in the pulse rate and blood pressure. Fortuyn (86) was of the opinion that the biochemical changes in the blood did not explain the variations in the clinical picture of hypoglycaemia, and he suggested a diencephalic mechanism. He considered that stimulation of this mechanism produced a mixed sympathetic-parasympathetic reaction. Mayer-Gross (87) has suggested that the difficulty in explaining the mechanism of hypoglycaemic unconsciousness in the precomatose stage and in coma might be related to two different levels of cerebral integration, i.e. cortical in the early stage and diencephalic in the later.

Most writers have found an increase in the systolic blood pressure during treatment. Robinson and Robinson (88) found a noticeable increase in both systolic and diastolic pressure within the first hour following the administration of insulin. The blood pressure reached its maximum as the blood-sugar concentration reached its minimum. Increased blood pressure was not an absolute indication of impending complications, but should be considered as a warning signal. Such an increase might be indicative of adrenalization, but might also be an indication of central pathological changes which might not be reversible.

Many detailed studies of the changes in the constituents of both the blood and the cerebrospinal fluid are available without throwing much light on the mechanism. Kingsley and Freed (89) showed that during treatment there were alterations in the volume of the cerebrospinal fluid and in the permeability of the blood cerebrospinal fluid barrier. Insulin caused a rise of globulin and a depression of the albumin-globulin ratio. These changes readjusted themselves to their previous level when treatment was discontinued.

Numerous reports are available on the effect of hypoglycaemia on the metabolism of glucose and oxygen in the brain and other tissues. Dameshek and Myerson (90) have demonstrated that brain metabolism is diminished when the brain is deprived of its main food-stuff, such as during insulin hypoglycaemia. Wortis and Goldfarb (91) made metabolic studies in 45 schizophrenics before, during and after treatment by insulin. Before treatment the arteriovenous oxygen differences of the schizophrenic brain did not differ from normal; neither was any change noted in the observations made after treatment was completed. During regular coma, however, the arteriovenous difference was

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found to be reduced, even after allowing for the possible changes in the blood-flow. Within an hour after the injection of insulin the arterial carbon dioxide content was raised, but it returned to normal within 30 minutes after the administration of glucose. It was noted that in those patients who developed seizures a sharp rise in the carbon dioxide level was found before the convulsion developed. They concluded that there was a depression of the respiratory centre during insulin hypoglycaemia which resulted in a decreased sensitivity to the normal stimulus of carbon dioxide.

The consumption by the brain of oxygen and glucose has been investigated by Himwich, Bowman, Wortis and Fazekas (92). There was no diminution of oxygen or glucose utilization when small doses of insulin were employed. With doses of 40 units or over the diminished metabolism was apparent. This diminished utilization of oxygen by the brain supports the view that carbohydrates are the chief energy supply of that organ. They found, also, that there was an increase in the alkali reserve of the blood as it passed through the brain. There was no change in esterase activity as the result of intensive hypoglycaemia.

They considered that the neurological manifestations were dependent on biochemical changes. With the depression of the cerebral mechanism were associated first, symptoms of excitement of the central nervous system and then of depression. Sweating, extensor spasms and motor activity all appeared according to the degree of diminution of cerebral oxygen uptake. Deep coma was constantly associated with greatly diminished utilization of oxygen by the brain.

Their study suggested that mental activities, like the neurological, were dependent on brain metabolism as the effect on the mental functions paralleled those on the reflex changes. Both normal and pathological processes were similarly affected, being simultaneously released at one time and depressed at another. The mechanism by which the pathological process is restored to normal is not disclosed.

An effort was made to correlate the clinical findings, the brain metabolism of glucose and oxygen and the electroencephalographic findings recorded during treatment by Himwich, Frostig, Fazekas and Hadidian (93). Their results confirmed that with the development of symptoms of hypoglycaemia there was a decrease of brain consumption of glucose and oxygen and a diminution of the alpha waves. The regression of these changes was apparent as the degree of coma lessened.

With regard to the possible mechanism of the action of insulin in the treatment of schizophrenia, Hoffman (94) put forward experimental proof that the anoxic and the hypoglycaemic syndromes involved the same physiological mechanism. As the result of his experiments he concluded that hypoglycaemia acted on the central nervous system in a way similar to that of oxygen deficiency and in both, the rate of oxidation was reduced, that the sensitivity of the central nervous system to oxygen deficiency was greatly increased in hypoglycaemia, and that the combination of hypoglycaemia plus oxygen deficiency induced by insulin produced a more effective stimulation of the sympathetic nervous system. He inferred that insulin improved schizophrenic patients by the same

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mechanisms which were called into play in the animal experiments described, firstly by reduction of the oxidation rate of the central nervous system, and secondly by stimulation of the sympathetic centres.

Autonomic activity during insulin therapy has been noted by many other investigators. Gerard (95) noted the autonomic changes without ascribing any specific therapeutic effect. That there is normally a reaction to the injection of insulin tending to antagonize it and restrain its effect is shown by McDonough (96), who found that completely sympathectomized dogs were markedly hypersensitive to insulin, a small dose in the absence of sympathetic reaction producing much more effect.

There are differences of opinion as to whether the sympathetic or the parasympathetic plays the major role. Gellhorn (97) was of the opinion that both asphyxia and hypoglycaemia elicited predominating signs of sympathetic and not of parasympathetic stimulation, and that this phase of hypoglycaemia seemed therapeutically important. Parker (98) has noted a fluctuating change in autonomic activity with parasympathetic predominance in the first stage, sympathetic in the second, followed by parasympathetic during deep coma. Fortuyn (87) concluded that an increase of both the parasympathetic and sympathetic components resulted from hypoglycaemia. Increased gastric motility and secretion were indicative of the stimulation of the former, while the alteration in the blood pressure, acceleration of the pulse rate and the perspiration so frequently seen were the result of the stimulation of the sympathetic.

Repeated examinations have been made to ascertain the presence of pressor substances in the blood so as to determine more accurately the effect of hypoglycaemia on autonomic activity. Tietz (99) observed a rise of blood adrenaline during insulin coma, which supported the view that there was an activation of the sympathetico-adrenal mechanism. His results suggested that there was retention of a fairly high and constant level of adreno-cortical substances in the blood of patients who had recovered after treatment with insulin. Cameron and Jellinek (100) concluded from their observations that prior to treatment there was a degree of adreno-sympathetic impairment, and that this was overcome in large measure in those patients who recovered and relatively unaffected in those who were unimproved. They suggested that the failure of some patients to respond to the treatment might be due to irreversible damage or to constitutional inadequacies in the autonomic mechanism.

Insulin resistance.—Because of the failure on the part of certain patients to develop hypoglycaemia, investigations have been made to determine the possible presence in their blood of substances antagonistic to insulin. Meduna (101) and his co-workers claim that the blood of 60 per cent. of the schizophrenic patients which they tested had an antagonistic effect on the action of insulin. They were of the opinion that there was a biochemical disturbance in schizophrenia, and that this disturbance indicated the presence of an anti-insulin substance in the blood of schizophrenic patients. They put forward the suggestion that the failure of the organism to adjust this disturbance might be one of the aetiological factors in the illness itself. Harris (102) investigated a group of 13 schizophrenics, and tested their sensitivity to test doses of insulin

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according to the method of Csépai and Ernst. Some showed a normal response, others either a decreased or an increased degree of sensitivity. Seven were studied by a method similar to that of de Wesselow and Griffiths with regard to the possible presence of substances in the serum which affected the action of insulin. The serum of some showed a pronounced antagonistic effect, while that of others showed little or no effect.

Himsworth (103) was of the opinion that blood contained a substance necessary for the activation of insulin, and that insulin resistance was due to an inadequate amount of this activating substance. This, as Harris (102) pointed out, does not account for those cases in which an injection of blood or serum has an antagonistic effect on the action of insulin in the experimental animal. It is possible that the amount of substances in the blood which increase or decrease the activity of insulin may vary with different persons. The results of Harris throw doubt on the importance of an anti-insulin mechanism in the pathogenesis of schizophrenia; further investigation is obviously required. No correlation was found between the tests and the subsequent dose of insulin required to produce coma during treatment.

Freeman, Looney, Hoskins and Dyer (104) report the results of their investigations on 32 schizophrenics and 20 normals. They found that 41 per cent. of the patients showed some degree of resistance to insulin, and they were in agreement with the results of Meduna (101). They suggested that the specific factors responsible for insulin sensitivity were of endocrine origin, since resistance to insulin has been recorded by Fraser (105), etc., in endocrinopathies involving the adrenal cortex, the thyroid and the pituitary. It is possible that this insulin insensitivity in schizophrenia may be another example of the general tissue resistance to change recorded by Angyal, Freeman and Hoskins (106).

Electrocardiographic findings.—The most frequent change found in the electro-cardiogram during treatment is a depression and inversion of the T-wave. The observations made by Messinger (107) suggested that this change was reversible, and might be produced by small as well as large doses of insulin. Goldman (108) found that after repeated treatments the abnormality persisted for periods up to six months. Barker, Shrader and Ronzoni (109) found a similar change in alkalosis. Goldfarb and Bowman (110) thought the change might be due to some cause other than insulin. They found that this change was identical with the electrocardiogram obtained from conditions where the causative agent was a vitamin deficiency, and that such could be reversed or prevented by the administration of vitamin B_1. They concluded that the change was due to the repeated consumption of large amounts of glucose, a vitamin-free substance, producing thereby a relative insufficiency.

Electroencephalographic findings.—It is generally accepted that, as has been reported by Finlay and Macfie Campbell (111) and others, there is nothing consistent or diagnostic in the electroencephalographic tracings taken from schizophrenics. A great many variations may be obtained, none of which is specific to this type of illness. Similarly, no special type of tracings have been found in patients treated with insulin. McNeil, Dewan, Meyers, Procter and Goodwin (112) report in a series of patients in whom they made parallel

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psychological, psychiatric and physiological examinations while under treatment by insulin, that they were unable to observe deteriorative changes in the cerebral cortex, as recorded by the electroencephalograph. They report that the quality of the electroencephalographic recordings was consistently lower than normal, but that they were otherwise representative of the population as a whole. The catatonic patients examined, who showed a marked inertia, had a frequency greater than the average. Similar results were reported by Hoagland, Ruben and Cameron (113). They found a progressive decline in frequency which showed a time relationship with the low blood-sugar level, and that sugar injected during treatment restored the frequency. They believed that the alpha frequencies were directly proportionate to the rate of carbohydrate metabolism of the cells of the cerebral cortex.

Histopathology.—Much experimental work has been carried out on animals to ascertain the effects of hypoglycaemia on the central nervous system. These have shown that following severe hypoglycaemia definite pathological changes, especially cellular changes, both focal and diffuse, occur there. Neumann, Cohn and Katzenelbogen (114) carried out experiments on cats, to which insulin was given in doses sufficient to produce coma. Subsequent pathological examination showed acute nerve-cell changes in the form of chromatolysis and swelling, cytolysis or karyolysis being present in almost every case, but not uniformly distributed. In the cerebral cortex the small nerve cells were chiefly involved. In those animals who died of hypoglycaemic shock the nerve-cell destruction was more widespread. Winkelman and Moore (115) found in cats which died as a result of deep coma that there was severe damage to neurones. Involvement of ganglion cells was apparent and there was an increase of glia. In their opinion the changes were more severe than those resulting from convulsive therapy.

Tannenberg (116) exposed rabbits to anoxic shock by slow deprivation of oxygen, and compared the results with those found in another series of rabbits injected with insulin in doses sufficient to produce coma and convulsions. The symptoms which developed were similar except that those seen in the rabbits exposed to anoxia were more rapid in development. The pathological changes were much the same in the central nervous system as well as the heart, skeletal musculature and liver. In the nervous system there were varying degrees of degenerative changes in ganglion cells with reactive glial proliferation. The cerebral cortex, the Purkinjë cells in the cerebellum, the cornu ammonis, the medulla and spinal cord were usually involved. These changes they considered to be best explained by the deprivation of ganglion cells of carbohydrates, which are, according to Himwich, their chief nutritional material. The hydropic changes found in the heart, skeletal musculature and liver were usually reversible. In the brain, however, single ganglion cells of various areas were destroyed, and they put forward the suggestion that this was perhaps a necessary step in the effective therapy of schizophrenia.

Finley and Brenner (117) carried out similar experiments on adult *Macacus rhesus* monkeys, in whom they produced hypoglycaemic coma and allowed this to extend from 3½ to 20 hours. After shorter periods of coma there was acute swelling and vacuolation of the ganglion cells, and they considered that

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these changes were reversible. After more prolonged periods of coma the changes were clearly irreversible, and consisted of marked swelling of the astroyctes and a marked microglial reaction and swelling of the capillary endothelial cells. The changes were more marked in the cerebral cortex. In animals exposed to repeated comas they found severe extensive lesions in the cortex of each. They were of the opinion that there was first a proliferation and hyperplasia of astrocytes, followed by an intense glial reaction with damage to nerve cells. This led to complete disappearance of nerve cells from the affected area, with a subsequent increase in the number of glial cells. It was probable that the lesions represented the cumulative result of minor brain damage.

Reports are now available of numerous pathological examinations of the nervous system of patients who have died following hypoglycaemic treatment. The changes found show a considerable degree of similarity to those already recorded in experimental animals.

The degree of change found by McKeith and Meyer (118) in the ganglion cells was considerably less than has been reported by several others, and there was only slight evidence of typical ischaemic necrosis. The predominant feature was a proliferation of the fibrous glia, most marked in the cerebral and cerebellar white matter and the globus pallidus. The changes found favoured an anoxic process.

Ferraro and Jervis (119) are of the opinion that the striking pathological changes of the blood vessels of the brain indicate the direct damaging action of insulin. They assume that the cellular waste of brain tissue in severe hypoglycaemia is brought about by a mechanism of anoxia involving biochemical facts and vascular changes. The amount of oxygen conveyed to the tissue by the blood vessels is reduced, since high doses of insulin produce proliferative changes in the vessel wall leading to narrowing and obstruction of the lumen.

It would appear that the degree of reversibility of these changes is dependent in large measure on the depth of coma. Whether or not there is any therapeutic value in a certain amount of brain damage, as has been suggested, remains undecided.

Conclusions.

In the ten years which have elapsed since the introduction of insulin therapy an enormous number of variations in the technique have been advocated, and these have been discussed. The necessity for individualization is stressed, and the employment of such degrees of coma as the clinical condition warrants. In this, much benefit may accrue from the regular administration of the treatment by one experienced physician.

Insulin therapy does materially alter the clinical picture in schizophrenia, even up to the complete abolition of the symptoms. It also shortens the duration of the illness.

There is an increased rate of improvement in acute cases as compared with controls. As time passes the discrepancy between these two groups, though still apparent, becomes less marked.

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Apart from those who recover, others show a marked temporary improvement which they are unable to maintain. The reasons for this offer a field for further investigation.

The various clinical factors that may influence the prognosis have been given, and the possibility of additional prognostic help from psychological performance tests has been discussed.

Various views on the mechanism have been considered, particularly in relation to the effect of treatment on the oxygen and glucose consumption of the central nervous system and on the autonomic nervous system. These factors, while relevant, do not in themselves adequately explain how the psychosis is benefited.

Certain dangers are associated with the method and there is the risk of persistent brain damage, but agreement is felt with Jessner and Ryan (120), who state: "In view of the gravity of a schizophrenic psychosis, it would appear that despite the possible occurrence of damage not clinically detectable, the risk involved should not necessarily be regarded as prohibitive if there is a chance for improvement."

Insulin therapy remains only a method of treatment; to be most effective it must be combined with all other therapeutic facilities, re-educational, psychological, occupational, etc.

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PREFRONTAL LEUCOTOMY.

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THE operation of prefrontal leucotomy or, as some call it, prefrontal lobotomy, is one of the most startling of modern therapeutic procedures. It was introduced in Portugal by Moniz (1936)—the actual operation being performed by Lima—and was subsequently developed in Italy and in America. In this country it was first carried out at the Burden Neurological Institute in Bristol on December 11, 1940. At the time of writing (May, 1943) some 350 leucotomies have been performed in Great Britain. In 1942 Freeman published his book, *Psychosurgery*, dealing with the work done up to the end of 1941. Most of the work dealt with in the present review has been published since then, although for the sake of completeness Freeman's book will be referred to.

There has been little reference to prefrontal leucotomy in any available German or Italian literature since the beginning of the war, but it is quite possible that papers on the subject have appeared on the Continent and have not been available to American and British abstractors. There has been some hostile criticism of the operation by medical men with no experience of it and little experience of psychiatry. Time alone can tell whether the initial success is going to be developed until the operation is accepted as an essential part of our therapeutic equipment. It seems a pity that such a technical matter as a prefrontal leucotomy should be discussed in the lay press, and we can only deprecate very strongly the action of medical men who have encouraged this.

EXPERIMENTAL WORK.

The frontal lobe is considered to be one of man's most precious and most peculiar structural endowments. It serves to distinguish him from the great apes. The development of the prefrontal lobes is associated with the more intellectual types of man, and yet we have the suggestion made that they be surgically mutilated or severed from the rest of the brain in an attempt to cure a mental illness, sometimes of long standing.

Golla (1943) points out that the static view of the central nervous system has to be abandoned and a more labile conception adopted. If the brain is damaged and cannot work in one way it will re-orientate itself and work in another. In some cases the brain by a circuitous route will perform the same functions, possibly not quite so well, but possibly also in some cases even rather better than before. Golla points out that if irreparable damage has not been done to the brain before operation, the patient may learn to use other mechanisms for his mental operation and may use them every bit as well.

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The tracts which theoretically should be divided by the section of the white matter are (Fulton, 1938) the *corticothalamic* system connecting the dorsal medial nucleus of the thalamus with the cortex, the *prefrontopontine* system (generally known as Arnold's bundle; and in the macaca monkey coming from areas 9 and 10 and terminating in the substantia nigra and dorsomedial pontine nuclei), the *corticomesencephalic* tract—a compact bundle of fibres rising in the prefrontal region in the same area as Arnold's bundle and passing along the medial tip of the cerebral peduncle—and the *corticostriate* system, which passes from the prefrontal area to the globus pallidus. In addition to these named fibre systems there are other association systems passing to other areas of the cortex.

The rationale of the operation of prefrontal leucotomy is based chiefly on severing the fibres connecting the prefrontal cortex with the dorsomedial nucleus of the thalamus. Earl Walker (1940) gives a very good account of this nucleus. He points out that various workers have shown the existence of fibres passing both from the prefrontal cortex to the dorsomedial nucleus and vice versa. Degeneration in this nucleus has been found by many investigators after lesions of the prefrontal cortex (see " Pathology," p. 498).

In the macaca monkey Walker found that the dorsomedial nucleus projects to the greater part of the prefrontal cortex on the lateral and inferior surfaces of the frontal lobe. The medial part of the dorsomedial nucleus which is related to the hypothalamic structures sends its fibres to the orbital surface of the frontal lobe, which is a cortical centre for the vagus nerve (Bailey and Bremer, 1938). The lateral parts of the nucleus project to the cortex of the convexity of the frontal lobe. Earl Walker points out that lesions of the medial thalamic nucleus made by himself and Jacobsen in several macaca monkeys trained in various psychological tests, produced no apparent change in the animals' behaviour and no impairment of their ability to perform delayed reaction tests.

Earl Walker (1938) points out that the neothalamic portion of the nucleus medialis dorsalis sends its fibres to the granular region, more particularly to area 9. There is a spatial organization in this projection; an antero-posterior plane in the nucleus projects to each point of the prefrontal cortex. The radiation is arranged in laminar fashion, for the paralamellar part of the nucleus projects to the cortex along the inferior precentral sulcus—the inferior portion medially and the superior part laterally. The medial and dorsal parts of the nucleus send their fibres to the dorsal and anterior parts of the granular frontal cortex. There is a certain antero-posterior relationship in the projection, for the anterior parts of the nucleus project to the cortical areas slightly more anteriorly than the posterior parts of the nucleus. The fact that a plane rather than a point in the nucleus projects to each point in the prefrontal granular cortex allows ample opportunity for complex integrations to be made at both the thalamic and cortical levels. Walker also points out that in lesions of the frontal lobe in man, primates and even carnivora, there is at least one common defect, one of association. In monkeys it is best demonstrated as a defect of reproductive memory; in man it manifests itself as an inability to synthesize the problems or situations of the external

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world. It is possible that the nucleus medialis dorsalis serves as an integrating centre for somatic sensory and visceral impulses, presenting them to the cortex of the prefrontal region in a complex form. He points out that it is unlikely that association with the auditory and visual systems is made through this nucleus, but well-known association tracts, the occipito- and temporo-frontal tracts connect the cortical centres of these systems with the prefrontal cortex, and by means of these tracts such associations can readily occur. If such were the sole connections of this nucleus, its main contribution would be the integration of elaborated afferent somatic sensory and visceral impulses and their projection to the cerebral cortex, not as sensory modalities, but as sensory concepts.

Strasburger (1941) points out that different cortical fields have special functions, but it is not easy to define them accurately. We know almost nothing of the role of the specialized cortical cells or the layers in the total performance, and nothing of the nature of engrams or the substrata of perception and ideas.

Goldby (1943) found in his work on the phalanger thalamus that in three cases, when the prefrontal area was damaged, there was severe degeneration of the dorso-medial nucleus. In the two instances where this was most pronounced, there was complete degeneration of the lateral small-celled part of the nucleus, occupying about a third of the transverse area of the whole nucleus anteriorly, and about a half posteriorly. The area of this nucleus which lacks corticopetal connections is large in the phalanger, but is reduced to a very small area in man (Le Gros Clark and Russell, 1940).

Richter and Hawkes (1939) found that removal of the frontal poles of the brain in the rat gave rise to greatly increased activity together with greatly increased food intake.

Waller (1940), from experiments on cats, found degeneration in the medial nucleus of the thalamus after lesions in the frontal lobes involving the gyrus proreus. The lateral part of the medial nucleus is connected to the upper part of the frontal granular area (Brodmann and others). The medial part sends its fibres to the lower granular cortex.

Warden, Barrera and Galt (1942) found in three monkeys that unilateral ablation of the frontal lobe had no effect on the retention of either simple or complex visual discrimination problems. When both frontal poles were injured simple discrimination was lost and only re-learned with difficulty. Complex discrimination was lost and could not be re-learned even after a thousand trials. Memory function appears to be concerned in all these types of problem. Unilateral ablation had no effect on the retention of the single platform instrumentation habit. The more complex stages of the double and triple platform habits were disturbed. Bilateral injury has no effect on the single platform habit, but the triple platform habit was entirely lost. No recovery of function was shown after retesting multiple platform instrumentation five weeks after bilateral injury. All the animals showed a general decrease in emotional tone during the tests after bilateral ablation. Rage and baring of teeth when frustrated entirely disappeared after operation. In some monkeys "neurotic" reactions occurred after unilateral ablation, e.g.

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rolling about the floor, biting hands and feet, pulling out hair, displaying facial contortion; these symptoms never occurred after bilateral ablation. Bilateral ablation also was instrumental in changing the degree of dominance in some pairs of monkeys.

Harlow and Dagnon (1943) found that monkeys after bilateral prefrontal leucotomy made more errors than normal monkeys in learning both a series of discrimination problems and a series of discrimination-reversals. They considered that these results were due either to a general decrease in ability to adapt to new situations, or to a loss within some more specific function which acts to facilitate discrimination learning and reversal. These authors also found that additional training reduced the number of errors.

Spaet and Harlow (1943) found in two rhesus monkeys that after bilateral removal of the prefrontal areas, the animals were able to respond successfully to delayed reaction problems tested by means of a matching from sample technique, but there was undoubted impairment which might result from loss of speed in learning, loss of effectiveness of "expected" reward and difficulty in reversing symbolic associations.

Malmo and Kleinfasser (1942), as a result of their experiments on monkeys, in which they had removed the frontal association areas on both sides, suggest the hypothesis that removal of the frontal association areas in primates leads to a marked impairment of their general capacities for memory, because the loss of these areas renders them more susceptible to retroactive inhibition.

Harlow and Johnson (1943) found in two rhesus monkeys, after bilateral destruction of the prefrontal areas, a deficit in response to a simple problem which does not involve the formation of any new association, or the utilization of any principle or symbolic process.

Shenkin and Ruch (1943) point out that bilateral ablation of area 13 on the orbital surface of the cerebral cortex in monkeys produced many of the symptoms which have been described following prefrontal lobectomy. They found hyperactivity consistently obtained, but other motor activities which were not marked by hyperactivity suffered reduction. Random spontaneous activities and posturings were reduced in variety and in quantity, as was emotional expressiveness. There were also certain ill-defined behaviour changes. Hyperactivity was accompanied by loss in weight and a slight increase in food intake. The monkeys do not react to the presence of visitors as do other monkeys; they show no fear. In man, area 13 is far back towards the olfactory striae and is probably not affected by prefrontal leucotomy.

Finan (1942) found in monkeys that when the frontal association areas on both sides were ablated, there was a complete loss of the delayed response. When the delayed response was made similar to discriminative learning by reinforcing the presentation trials, the response was partially reinstated.

Smith (1942), in experiments on cats, found after ablation of the frontal lobes considerable hyperactivity. These cats showed forced following-responses to visual stimuli. The hyperactivity involves in part at least the modification of the inhibitory mechanisms of control of visual orientation.

Epstein and Morgan (1943) conclude from their experiments on rats which had had their prefrontal areas removed, that the fractional goal reaction in

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maze behaviour involves symbolic processes which are mediated by the prefrontal cortical areas.

Morgan and Wood (1943) found from experiments on rat brains that animals with bilateral prefrontal lesions lost their ability to use recent memory. From this they conclude that in the rat there is a prefrontal association area for recent memory, or possibly " an ability to maintain a set in the face of distraction."

Indications and Contra-indications.

In what is to a certain extent an experimental procedure and certainly a surgical treatment in its early development, it is not easy to lay down any rigid rules as to what types of case are most suitable for operation.

Freeman and Watts' (1943) opinion is worth quoting: " The individual who is ideally suited for prefrontal lobotomy is one whose emotions are largely concerned with himself. This is the patient who fears heart disease or cancer or syphilis or contamination; who is a prey to ideas of guilt or of persecution, who broods excessively on the terrors of the unknown future and who cannot make up his mind between this and that; who gets so emotionally disturbed on coming in contact with others that he is unable to think clearly; who sees death as the only solution to his difficulties. More difficult to influence satisfactorily are those persons who have drifted away from the world of reality, and who are constantly harassed by imaginary voices, visions, odours and by fixed ideas that keep coming again and again. Nevertheless, as long as there is a certain minimum of emotion that attaches itself to the ideas, a good result in terms of relief from distress can be anticipated. Only when the emotion dies out and the individual lapses completely into the dream world of psychosis with no struggle against the manifestations of disease, is he to be considered too emotionally deteriorated to be aided by psychosurgery."

The results published so far divide themselves into two groups, one in which the operation has been performed on chronic cases merely in the hope of making them easier to nurse, and the other in which the operation has been performed with the definite aim of curing the patient.

In the first group are found very largely the hostile, noisy and destructive catatonic types of schizophrenia, whether of long standing or not, and whether demented or not (Dax, 1943; Ström-Olsen, 1943; Rees, 1943; Cook, 1943; Carse, 1943).

The second group can be divided into (*a*) all types of mental illness when depression is the prominent feature, and (*b*) obsessional cases often very long-standing and chronic, where anxiety is the chief symptom (Hutton, Fleming and Fox, 1941; Fleming, 1942; Hutton, 1943; Fleming and McKissock, 1943).

With regard to the second group there is considerable difference of opinion as to when operation should be performed.

Rees (1943) considers that the indications for prefrontal leucotomy are functional mental disorders with symptoms of active conflict which have failed to respond to other methods of treatment, and where the prospects of spontaneous recovery are remote.

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Ström-Olsen, Last and Brody (1943) state that they are of the opinion that prefrontal leucotomy is of benefit in the chronic type of psychotic patient described in this paper, but in view of the risk of producing undesirable new symptoms, both mental and physical, the operation should only be undertaken when all other methods of treatment have failed, and where it can reasonably be assumed that the chances of remission or recovery are very remote.

Fleming (1943) considers that leucotomy may well be performed at an early stage without any previous treatment.

Cook (1943) considers it wise to confine the operation to those who have not responded to other forms of treatment, or who have been in a state of mental disorder for some time.

Banay and Davidoff (1942) performed a leucotomy on a sex psychopath who, six months after operation, showed a perfact adjustment to his environment. His state of agitation, emotional panic and diffuse sympathetic discharges disappeared, as well as the elaborate sexual fantasies. There was no intellectual impairment. The authors consider that persons over fifty years of age, whose pathological sexual desires are increasing with their declining years, and whose history consists of persistent criminal sex offence of obsession-compulsion type, accompanied by marked agitation or other emotional disorganization, appear to be suitable cases for leucotomy.

The *contra-indications* have received little attention in the papers published. They are more a matter for the neurological surgeons to deal with. Generally speaking, they consist in the usual contra-indications to surgical operation. A high systolic blood pressure and a diastolic of over 100 mm. Hg are regarded as dangerous (McKissock, 1943*b*).

Freeman (1942), on the other hand, states that he has operated on patients with a diastolic of 110 mm. Hg and even 128 without any evil effects.

Willway (1943) does not regard age *per se* as a contra-indication, having operated on three people over seventy. He has operated on hypertensives without any post-operative worries.

Lima (1943) reports that in Portugal the operation is performed chiefly on involutional psychoses and obsessives. Their results with schizophrenics were poor, but only very old cases which had already had insulin and cardiazol were operated on. Flores, in Lisbon, only has the operation done after convulsion treatment has failed.

To sum up, the present opinion amongst those best qualified to judge appears to be that almost any mental illness of long-standing duration, apart from chronic mania, epilepsy and general paralysis, is worthy of serious consideration for operation. Amongst recent cases, those which have proved resistant to electric shock treatment should be considered for operation.

Technique.

No two neurosurgeons appear to use quite the same method. The approach is the same for all, and after entering the dura is, of course, "blind" unless Lyerly's method of open operation is used. As far as I know the open method has not been used in this country. Lyerly (1942) cuts out a small window in

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the skull and is able to see exactly what he is dividing, and so control haemorrhage rather better. It must be admitted, however, that his results are no better than by using the quicker blind approach. For details of technique, which are beyond the scope of a short review, the papers of Ström-Olsen, Last, Brody and Knight (1943), Dax (1943), Willway (1943), McKissock (1943) and Freeman's *Psychosurgery* must be referred to. It would appear that the section has to be made almost immediately in front of the anterior end of the lateral ventricle. The ventricle, of course, must not be entered. Sections made too far forward do not appear to yield such good results.

There is considerable difference of opinion as to the instrument most suited for dividing the white matter. Crombie (1941) has invented a leucotome which cuts through an arc, Willway uses a narrow paper knife, and McKissock a blunt brain needle. The whole object, of course, is to divide the white matter without tearing or dividing any vessels.

McKissock (1943*c*) has devised a modified operation. In dealing with certain chronic obsessional states, where the underlying personality was of good quality and it was highly desirable to avoid deterioration after operation, a modified leucotomy was performed with the idea that, if this failed to produce an adequate therapeutic result, a more extensive section could be carried out at a later date.

In a small series of such cases section only of the lowermost fibres was performed ; no deterioration was produced, but the therapeutic effect was adequate in the opinion of the psychiatrists concerned.

This modified operation is carried out by introducing the brain needle at a point 3 cm. behind the lateral margin of the orbit and 6 cm. above the zygoma. The needle is directed inwards and slightly forwards to reach a point about 1 cm. lateral to the falx but in front of the tip of the ventricle and in the horizontal plane of the base of the anterior fossa. The point of the needle is made to travel downwards towards the base of the skull, keeping parallel with the falx by introducing the instrument a little more deeply, and thence across the anterior fossa to the lateral margin, withdrawing the needle in the process in order to avoid striking the grey matter and the sulci of the inferior surface of the frontal pole. No section of the fibres lying above the point of entry of the needle is made.

Seizures.

From the nature of the operation it was to be expected that consequent on the formation of scar tissue seizures might be expected to develop.

Goldstein (1942), in discussing the occurrence of epilepsy after penetrating wounds of the head, points out that between 15–20 per cent. suffer from motor epilepsy. Most of the epileptic attacks occur in the first two years after injury, but there was no evidence that individuals who have early attacks necessarily suffer later from epilepsy. The late attacks are usually due to scar formation. He found that 50 per cent. of all patients who had attacks in the first week of injury did not acquire permanent epilepsy. After head injuries epilepsy is most frequent after lesions in the parietal region, but lesions of the frontal lobe can also produce epilepsy usually of a more tonic character.

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None of the observers of seizures following on leucotomy report as to the nature of the attacks, nor do they as a rule report how soon after the operation.

Freeman (1942) in his book quotes Lyerly as having three instances of seizures in 44 cases of leucotomy performed by the open method. Freeman himself thinks that about 4 per cent. have seizures, most of these being in cases operated on by the superior approach, which appears to bring the cortical incision dangerously near the motor centres. He expresses the opinion that the smaller the incision through the cortex the less the likelihood of a focus arising subsequently. Freeman gives 15 instances in 150 patients, but not all were persistent; some have gone more than two years without another attack.

McKissock (1943) found four patients out of 50 had a seizure. Radley Smith (1943) found one patient with a seizure out of 62 cases operated on; Ström-Olsen (1943) one out of 30; Hutton one out of 50.

	Cases.	Instances of seizures.	Percentage with seizures.
Freeman	150	15	10
McKissock	50	4	8
Lyerly	44	3	7
Radley-Smith	62	1	1·6
Ström-Olsen	30	1	3·3
Hutton	50	1	2
Total	386	25	6·4

Goldstein very wisely points out the necessity of attending to the conditions under which patients live after head injuries, and these remarks may with advantage be applied to the prefrontal leucotomy cases. He considers as conditions to be avoided: the use of alcohol even in small doses, physical over-exertion, jarring in car or train, exposure to sun and irritations of any kind —mental as well as physical.

Incontinence.

Goldstein (1942) found in some cases where a projectile had damaged the frontal lobes at high speed that the patients lie down more or less motionless, but have no control of either bladder or rectum. These cases may improve after a few weeks. Freeman (1942) states that urinary incontinence is quite a common condition in the days following operation, but that it rarely lasts longer than two weeks. Rectal incontinence according to him is not so common. The patients seem to be mostly quite unconcerned about it. Fleming and McKissock (1943) state that one-third of their cases were wet. Only one out of the 15 cases was wet after the first month, and this case was quite unconcerned about it, although she had made a complete recovery mentally. They have the impression that the more severely affected mentally the patient is, the more likely is he to be wet after leucotomy. Ström-Olsen, Last and Brody (1943) found one-third of their cases with incontinence; half of these were only temporarily so.

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Psychological Changes.

Before considering the mental changes after leucotomy it is well to consider sundry findings reported by Goldstein (1942) in his book. He reports that he has seen men who, after a short period of unconsciousness, have stood up and walked a considerable distance with no symptoms other than headache after a high-velocity bullet had passed through both frontal lobes. He found that some cases with lesions of both frontal lobes showed a picture of a katatonia-like stupor. Frequently compulsive crying and laughing are observed in patients with frontal lobe lesions. His condition of homolateral hyporeflexia has not so far been reported after leucotomy, but is worth watching for. He describes disturbance of tonus and equilibrium occurring even years after injury. These consist of abnormal postures, involuntary deviations, startle phenomena, sensory errors, etc., and occur especially when the premotor area has been damaged. In the mental sphere he found an impairment in the capacity for abstraction, i.e. they become more concrete in their behaviour. He found faces usually rigid, lacking expressive movements, the patients slow and dull. He describes a " catastrophic situation "—this consists in a reaction to a simple problem, which the patient is unable to solve. He becomes agitated, looks dazed, starts to fumble, his pulse becomes irregular, he is sullen, evasive, and may even become aggressive. His patients avoided company; readjustment to any new situation was difficult. Another symptom he found was an excessive orderliness, probably to diminish the amount of effort required to lay hands on any object.

Goldstein describes a disturbance of the relation between figure and ground, the sharp differentiation of figure from background suffers, the two intermingling, and there may even be an inversion, figure becoming background and background figure.

He emphasizes the impairment of the attitude toward the abstract. The abstract attitude depends on assuming a mental set voluntarily; shifting from one aspect of a situation to another, making a choice; keeping in mind simultaneously various aspects of a situation; grasping the essential of a given whole, breaking up a given whole into parts and isolating them voluntarily, abstracting common properties, planning ahead intentionally, thinking or performing symbolically and detaching the ego from the outer world. Fleming (1943) found in a man, aged 62, who had a high conceptual quotient of Shipley-Hartford, both before and after his leucotomy, that he failed very badly on the progressive matrices, which may be regarded as a good non-verbal test of abstract reasoning.

Freeman (1942) sums up his findings very well. He points out that the person whose frontal association areas have been partially inactivated by prefrontal lobotomy presents a number of peculiarities that distinguish him from his pre-operative self. He is freed from anxiety and from feelings of inferiority; he loses interest in himself, both as to his body and as to his relationship with his environment, no longer caring whether his heart beats or his stomach churns, or whether his remarks embarrass his associates. His interests turn outwards and obsessive thinking is abolished. He responds immediately and sometimes vividly to external impressions, showing something of an

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emotional incontinence that makes for ready laughter or petulance. The emotional responses may be vivid, but they are lacking in depth and quickly evaporate. His mood is, on the whole, elevated, and the extraversion and ready response make for an apparently quick-witted enthusiastic individual who gets along superficially with everybody. There is something childish in the cheerful and unselfconscious behaviour of the operated patient. The intellectual equipment, in the sense of past experience, is undamaged, but close examination discloses certain defects that become more obvious in the case of extensive incisions. These intellectual defects immediately following operation consist in a certain rigidity in categorical attitude, in an inability to find new or different methods of solution for difficult problems, an inability to retain in consciousness simultaneously a number of concepts presented simultaneously; a disturbance of the temporal patterning of activity; a certain lack of ability to synthesize and to arrive at a correct solution after considering all the factors involved. In the ensuing months these defects become diminished or disappear completely. There is, however, an apparent inability to foresee accurately the results of a series of planned acts as they relate to the individual himself. There is a very distinct difference in the behaviour of the individual in the immediate post-operative phase and that which appears later on, when the patient has arrived at a stationary condition. The patient often behaves very much better before strangers than before his own relatives—they seem almost to enjoy offending their relatives for a while.

Hunt (1942), in Freeman's book, gives a good account of her studies on the Rorschach test before and after leucotomy. She found a more restricted and constricted personality with less variety and individuality of response. Form responses (F) were practically the same after as before; movement responses (M) were low both before and after. There was a slight increase of animal movement (FM) responses after operation. The ratio of movement to colour responses (M : ΣC) was significantly increased; this may mean a change in the direction of greater cheerfulness. There was a decrease in the total number of responses (R) after operation, and an increase in the number of D responses, which signifies a move towards normality. There was a noticeable increase of apathy towards the test. All these results were obtained soon after the operation. On six patients tested at longer intervals after the operation the author found general expansion, greater indication of intellectual adequacy and fewer indications of abnormality. There was an increase in total responses, better distribution of W, D, d and S responses, more movement responses, better proportion of good F responses and a more normal number and distribution of colour type responses. Hutton (1943) is able to confirm most of these findings.

Ström-Olsen *et al.* (1943), basing their opinion on psychometric investigations, point out that a considerable proportion of the schizophrenics cannot be properly tested. Among those who were tested it was obvious that lethargy, lack of spontaneity and an attitude of suspicion interfered with the results. After making these allowances they found that nine out of ten showed no defects after the operation. There was no relation between test performance and the appearance of an abnormal EEG. The battery of tests they used were :

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Terman Vocabulary, Revised Stanford-Binet, the "Discrepancy Test" modification of Babcock's scale, Kohs Blocks, Porteus Mazes, the Passalong Test, Progressive Matrices and the Shipley-Hartford. Brody and Hutton (1942) have prepared a battery of tests for use before and after leucotomy. This battery contains eleven tests which require between 25–40 minutes to administer; they consist of vocabulary, paragraph memory, Weigl, picture absurdities, cancellation, verbal absurdities, picture recognition, proverbs, recall, digits in all and sentences in all. The tests are administered before operation, and then six weeks, four months and one year after. Using the Shipley-Hartford Retreat Scale we have found no evidence of intellectual deterioration after leucotomy, although one patient who made a high score both before and after the operation did badly on the progressive matrices two months after operation.

Alford (1943) points out that the accepted characteristics of the frontal lobe syndrome consist of mental instability, a mild instability often too slight to give rise to confusion or complex formation. The disturbance in emotional control accounts for the change in character, the irresponsibility and impulsiveness and the elevations as well as the depressions of mood. There appears to be no indication that any part of the mental mechanism is lost with the removal of the frontal tissues.

Yacorzynski and Davis (1942) found in patients with unilateral lesions of the frontal lobes that the threshold of perception was raised, the number of objects perceived in ambiguous figures resembling the Rorschach test was decreased, visual illusions normally seen by everyone were either not perceived, or in the case of the Muller-Lyer illusion the illusion was exaggerated, memory for visually presented objects was decreased, and the reversals of figures with reversible perspectives, such as Rubin's figures, etc., were either absent or decreased. These authors suggest that the elation found in some patients with frontal lobe lesions may be due to the disturbed perceptual processes in which the ordinary inhibitory stimuli are no longer perceived as such.

Hebb (1941) found no significant alteration in the I.Q. after excisions of scar-tissue from the frontal lobe. He regards this as further evidence opposed to the localization of the Binet or performance test ability in the frontal association areas.

Re-education and Rehabilitation.

The re-education and rehabilitation of the prefrontal leucotomy patient is almost the most important part of the treatment. The patients are most suggestible and trainable, and for these reasons they should not leave hospital too soon. Their hospital period of convalescence should be prolonged.

Freeman and Watts (1943), in considering the convalescent care and rehabilitation of the leucotomy patient, point out that the patient is really an immature personality, and uses the trite expression for the immediately post-operative period of a "surgically induced childhood." This immaturity disappears as time passes, sometimes quite rapidly, but in some of Freeman and Watts'

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cases the process of social readaptation was not completed until for from three to five years after the operation. Out of a total of 170 cases operated on by Freeman and Watts (1943*b*) during the last six years, more than half are now usefully occupied. Of my own series of 35 cases during the past two and a half years, 26 have returned to their homes as resocialized and largely recovered individuals. These patients must be taken in hand firmly as soon as the immediate post-operative condition has settled down and given psychological treatment of various kinds, depending on the symptoms which have to be dealt with.

Results.

In estimating the value of the results quoted by the various writers, one has to remember that the cases chosen for operation by the British workers in particular have very largely been chronic cases of bad prognosis, cases which had failed to respond to any treatment. Fleming and Hutton are the only ones who have had leucotomies performed on patients who had had no previous treatment. The results of Carse (1943), who was able to discharge 10 out of 22 chronic schizophrenics, are most impressive.

(*a*) *Schizophrenia.*

	Cases.	Recovered or much improved.	Improved.	Not improved.
Hutton	32	9	14	10
Fleming	5	..	1	4
Dax	39	13	13	13
Rees	30	9	?	?
Ström-Olsen	11	2	4	5
Freeman	45	29	7	9
Carse	22	10	5	7
Total	184	72	44?	48?

(*b*) *Depressions.*

	Cases.	Recovered or much improved.	Improved.	Not improved.
Hutton	17	11	4	2
Fleming	19	16	1	2
Tarumianz	10	7	?	?
Dax	11	3	4	4
Lyerly	29	14	11	4
Ström-Olsen	7	2	1	4
Carse	1	1	..	..
Freeman	77	52	16	9
Total	171	106	37?	25?

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(c) *Other Psychoses.*

	Cases.	Recovered or much improved.	Improved.	Not improved.
Hutton	1	...	..	1
Fleming	6	6	..	..
Lyerly	9	2	3	4
Ström-Olsen	12	3	4	5
Carse	1	1	..	..
Freeman	48	29	12	7
Total	77	41	19	17

Pathology.

So far, apart from statements in Freeman's book, there has been no publication of a pathological investigation of material from a prefrontal leucotomy. Freeman reports investigations on three cases. In all three there was an isolated degeneration of the nucleus medialis dorsalis. In one case there was in addition degeneration of the cingulum and superior frontal gyrus; the degeneration in the thalamus spread to the nucleus antero-ventralis and possibly also to the nucleus ventralis lateralis. The large-cell portion of the nucleus medialis dorsalis was intact; this portion is supposed to connect to the hypothalamus rather than to the cerebral cortex.

In the degenerated portions there were few ganglion cells remaining, and these presented either swelling with pallor or shrinkage. There was an apparent increase in the number of small glia cells. There was present some dark staining material in the walls of the arteries of the globus pallidus. The cerebral cortex showed minor cellular change, apparently resulting from the terminal febrile state. There was local but very limited necrotic and reactive changes about the site of injury. No ganglion cells appeared to have disappeared; the lamination and polarity of the cells were satisfactorily maintained, and the cells presented no signs of axonal degeneration. There was no gliosis and no significant vascular change in spite of the relatively complete subcortical amputation of the frontal pole.

In one case there was a mild degeneration found in the anterior limb of the internal capsule by the Marchi method. The preservation of the nucleus antero-medialis in two of his cases he considers supports the idea that this nucleus projects on to the inferior surface of the frontal lobe, which was undamaged. Freeman also points out the importance of the degeneration and atrophy of the nucleus medialis dorsalis following leucotomy, in the alteration of the emotional life of the patient. He quotes a case reported by Stern (1939) in which there was apparently a primary atrophy of various thalamic nuclei, especially the nucleus medialis dorsalis on both sides, and in which the patient showed profound apathy, inertia and lack of emotional response for a long period preceding death. One case showed an extensive necrosis of the white matter except that lying under the gyrus rectus.

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Cortical Atrophy.

Dax (1943) reports three female agitated melancholics aged 35, 48 and 62 who had all failed to react to convulsions and who also failed to react to leucotomy. All showed shrunken frontal lobes. Alexander (1943) also reports having found marked cortical atrophy in schizophrenics at operation. They also had had convulsive therapy. The writer has had two cases, one of which recovered after leucotomy and did very well, but who had not had convulsive treatment, and one who had a severe cortical atrophy and did badly after both convulsive treatment and leucotomy. Another case of the writer's, a man, aged 62, had consistently resisted electro-shock even at 150 volts with repeated attempts and full duration. At operation the surgeon remarked that he had never operated on so "dry" a patient—there was practically no bleeding of any sort.

Mortality.

The death-rate is distinctly low. Freeman has had 4 deaths in 170 cases, Willway 2 in 90 cases, McKissock 3 in 120, Rees 2 in 30, Ström-Olsen 0 in 30, Dax 2 in 50 and Carse 2 in 27; a total of 15 deaths in 517 cases, a mortality-rate of 3·5 per cent. Of the 15 deaths, at least 9 were due to cerebral haemorrhage occurring within eight days of the operation.

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LEGAL ASPECTS OF PSYCHIATRY.

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This article deals with legal happenings, actual or prospective, in so far as they have a bearing on psychiatry. Both civil and criminal law are included, but no reference is made to juvenile delinquency, which is included in the article in this series contributed by Dr. Norwood East. No attempt has been made to deal with foreign literature or any changes in the law of foreign countries.

One of the most important legal changes affecting psychiatry in the period under review is the Matrimonial Causes Act, 1937, commonly referred to as *the Herbert Act*. This Act, which made five years' continuous detention for incurable insanity grounds for divorce, has raised many problems, which are gradually being solved by the courts, the Official Solicitors, the Board of Control and mental hospital officers. The subject is very fully dealt with by D. Harcourt Kitchin, Barrister-at-Law, in the *Medical Annuals* for 1939, 1940, 1941 and 1942. A problem still unsolved is what is meant by detention. In the Scottish Act a person is deemed to be under care and treatment while any order or warrant for his detention under the Scottish Lunacy Acts is in force. As the usual order in Scotland remains in force for 28 days while a patient is absent from hospital, there is no question of any break in detention in such cases. In England the question is very different, as shown by the cases Shipman *v.* Shipman and Green *v.* Green, where it was held that absence on trial for prolonged or indefinite periods interrupted detention. The question is fully dealt with in a Board of Control circular No. 861, which should be carefully studied by all mental hospital officers. The English Board of Control never loses sight of the fact that the medical aspect of mental illness must never be subordinated to the legal, and in Circular No. 861 is the characteristic sentence: "In determining, however, whether leave should be granted, those in charge of the patient should have regard only to the proper treatment of the patient under the Lunacy and Mental Treatment Acts, and should not be influenced by any consideration that might subsequently arise under the Matrimonial Causes Act."

In Hall *v.* Hall, 1940, it was clearly brought out that medical officers of Poor Law Institutions must be very careful to comply with Sec. 25 of the 1890 Act when receiving incurable patients from a mental hospital. In Murray *v.* Murray, 1940, which went to the Court of Appeal, the Master of the Rolls held that such patients discharged to a workhouse are still under their original reception order, and that it lapses if the usual continuation certificates are not given. It would appear, therefore, that many patients are being

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illegally detained in workhouses at the present time, either because the medical officer of the workhouse has not certified concerning the accommodation, or because their reception orders have not been renewed by report and certificate at five-yearly intervals. Habeas corpus orders and claims for damages for wrongful detention lie in these cases until Parliament grants an act of indemnity.

The information contained in patients' case-records must be made available to petitioners, and medical officers must give evidence when so required. These are rulings of the Board of Control, concurred in by the Minister of Health. In 1940 the President of the Divorce Division instituted a procedure whereby Medical Superintendents in certain circumstances are allowed to give their evidence as to the state of mind of the patient by affidavit.

Insanity and desertion (1).—An unintentional hardship of Herbert's Act is the ruling in Williams *v.* Williams, 1939, that if during the statutory period of three years necessary to provide grounds for divorce for desertion the deserting spouse is certified insane, that period is interrupted and the petitioner can no longer found his action upon the earlier act of desertion. In Rushbrook *v.* Rushbrook the judge held that the finding in Williams *v.* Williams precluded him from hearing any evidence to show that though certified the patient was in fact capable of forming an intention to desert. This means that desertion is the one matter upon which the court must presume, on the strength of a certificate alone, that the patient was incapable of forming an intention, for of course a certified patient can be found guilty of murder, can commit torts and make a valid will. However, if the patient is admitted as a temporary patient the court can hear evidence as to whether the patient while in hospital was capable of forming an opinion as to whether he wanted to go back to the other spouse (Monckton *v.* Monckton, 1941). In Sotherden *v.* Sotherden, 1940, however, the Court of Appeal made it clear that a patient in a mental hospital could be deserted, and on discharge bring a successful action for divorce on the grounds of three years' desertion immediately preceding the petition.

Temporary patient and divorce (2).—It has not yet been decided whether the original period of treatment as a temporary patient is detention for divorce purposes. The importance of this is that treatment as a voluntary patient under the 1930 Act counts as detention if it follows immediately a period of detention in pursuance of "any order." Unfortunately, Herbert's Act does not say whether temporary treatment counts as detention. However, it was decided in Benson *v.* Benson, 1941, that if the original period of six months is extended under a "direction" of the Board of Control then the patient is detained within the meaning of the Act.

Marriage annulled for fits of insanity (3).—Smith *v.* Smith, 1940, was the first case tried under Sect. 7 (1) (*b*) of the Herbert Act. This section deals not with divorce but with annulment of marriage on certain grounds, one of which is that husband or wife "was at the time of the marriage of unsound mind or a mental defective, or subject to recurrent fits of insanity or epilepsy." The petitioner has to satisfy the court on three points, viz. ignorance of facts alleged at date of marriage, proceedings taken within year of marriage, no marital relations since discovery of facts alleged. The court found it proved that the wife was subject to recurrent fits of insanity, and the judge pointed

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out that proving this was a different thing from having to prove that she was suffering from a fit of insanity at the time of the marriage.

Criminal Justice Bill.—Recognition of the contribution that psychological medicine has to offer in the treatment of the criminal was implicit in the Criminal Justice Bill introduced into the House of Commons by Sir Samuel Hoare in 1939. The Bill was controversial, and because of the outbreak of the war the Government decided to withdraw it.

Among the reforms proposed by the Bill was abolition of prison for offenders under 16, and for those between 17 and 21 unless careful investigation suggested otherwise. Remand homes were to be set up for abnormal children and young persons in need of mental observation and treatment. Penal servitude, hard labour and ticket-of-leave were to be abolished, as was corporal punishment, except for mutiny and gross assaults in prison.

Feversham report (4).—This valuable report appeared in July, 1939, and deals with the voluntary mental health services. It recommends the amalgamation of the various voluntary bodies dealing with mental health, the chief of which are the Mental After-Care Association (founded in 1879) dealing with discharged patients, the Central Association for Mental Welfare (1913) dealing with mental defectives, the National Council of Mental Hygiene (1920) for the promotion of research and the instruction of doctors and the public in mental health problems, and the Child Guidance Council (1927). Unconnected with these bodies many out-patient psychiatric clinics and child guidance clinics have been established, some under unofficial management, others under Local Authorities. The committee points out the inevitable competition, overlapping and waste of effort inherent in the present arrangements, and is of opinion that these would be largely removed by their proposed amalgamation. Besides mapping out the field and making a number of administrative recommendations, the committee suggest several amendments of existing legislation. Increased use of Sect. 6 of the Mental Treatment Act, 1930, whereby Local Authorities are authorized to subsidize voluntary organizations is stressed. They strongly recommend the setting up by every Local Authority of a mental health committee which would have under its control all mental hospitals, mental deficiency services, psychiatric clinics, child guidance activities and arrangements for examination of delinquents. It would maintain close touch with the public assistance committee dealing with rate-aided mental patients and should contain representatives of the local voluntary services. This would ensure co-ordination of all mental health activities of the locality. The committee strongly condemns the present law whereby the Mental Deficiency Acts set up one criterion of mental deficiency and the Education Acts another. It recommends that the Mental Deficiency Acts should adopt the criterion of social inefficiency and omit all reference to educational incapacity, and that the Education Acts alone should be concerned with educational incapacity and its notification to the mental deficiency authority. The term "mental defective" should be reserved for cases notified to the mental deficiency authority. The committee also points out that the present law by which only children educated in special schools or classes can be notified to the mental deficiency authority debars many a child from being given the education suited to its capacity.

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In other words, if the child is neglected in the first place, this very fact debars it from subsequent attention. The committee suggests that the Education Act should be amended to require local education authorities to notify all children between 7 and 16, ascertained to be defective, who are about to be removed from school and who in their opinion would benefit from supervision, guardianship, or care in an institution. The committee also recommends that defectives should have the option of treatment in institutions as voluntary patients, and that a national clearing-house should be established to deal with difficult cases.

Divorce legislation in Scotland (5).—As it followed the Herbert Act it is not surprising that the Divorce (Scotland) Act, 1938, shows certain improvements on the former Act. In Scotland the court cannot grant a decree of divorce for insanity if the pursuer has during the marriage been guilty of wilful neglect or misconduct which has conduced to the insanity. As with the Herbert Act, continuous detention for five years immediately preceding the petition is necessary to prove incurable insanity, but here such detention is presumptive proof of incurability, whereas in the Herbert Act the court has to decide on the evidence whether the patient is incurable or not. Again it is laid down that a person is under care and treatment while any order or warrant for his detention is in force, or while the meaning of those words in the Herbert Act is satisfied. The Act settles in advance the question which arose in Shipman *v.* Shipman by laying it down that the necessary "continuous detention" is broken if the patient is absent from hospital, with or without leave, for more than 28 days, or if though in the care of the hospital staff he is absent for more than three months.

The court must appoint a curator *ad litem* to the defendant in any action of divorce on the grounds of incurable insanity, and the General Board of Control for Scotland, on the request of the court, must furnish to it a report on the probability of recovery of the defendant. Such information with other details the Board obtains from the medical superintendent of the hospital of which the defendant is a patient.

Assault by mental defective (6).—A case of great importance to all medical officers in institutions for mental defectives was decided by judge and jury at Liverpool in June, 1937. Damages totalling over £4,000 were given against a Medical Superintendent and his deputy for allowing out on licence a dangerous patient, who while on licence savagely assaulted an old lady by beating her over the head with a piece of wood. This case showed that those responsible for mental defectives obviously run great risks, and will have to remember that they license at their peril persons with a record of violent behaviour.

Detention of mental defectives (7).—In July, 1938, Parliament passed an Act which gave a month's grace for the continuation of any order made under the Mental Deficiency Acts and regularized all current orders which had been made in good faith. This Act was passed in consequence of the finding by the Court of Appeal in R. *v.* Board of Control, where a defective named Winterflood applied for a writ of Habeas Corpus on the grounds that he was wrongfully detained. He had been certified in 1929 on an order that expired on June 23, 1931, and had then been detained on a continuation order made on June 29,

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1931. It was held that this latter order was invalid, and that the keeper of the institution had no legal authority to hold the defective after June 23. It was pointed out that if some provision was necessary for the temporary custody of defectives after their orders had expired while the Board of Control were considering their cases, such provision must be sought from Parliament. This decision put insuperable administrative difficulties in the way of the Board of Control, in addition to rendering many current orders invalid. The new Act corrects an unsuspected flaw in the Mental Deficiency Act, 1913, s. 11 (1), under which defectives are detained.

Testamentary capacity and mental disorder (8).—It is a well-established principle of law that to have a "sound disposing mind" a person need not be completely sane, or have an accurately balanced mind, but he must have a reasonable appreciation of what he is doing when making his will. Following this principle Mr. Justice Laughton at the end of 1937 in *re* Bohomann went so far as to find that one part of a codicil was tainted with delusion and therefore invalid, while the remainder was valid. The testator had made his will in 1926 and added four codicils, the last in 1932. It was brought out in evidence that he had a delusion that the London County Council were persecuting him, and the judge decided that it was this delusion which made him in his last codicil direct that the word "England" should be deleted and "United States" substituted for it in his gift to charities, with the result that American instead of English charities would benefit. The judge held this part of the codicil to be invalid, and agreed that he was going a step beyond the existing legal decisions in saying that one part of a document was good and another bad, but considered that he was only deleting from the fourth codicil something which was never brought to the knowledge and approval of the testator as a sane, well-balanced man.

Electroencephalogram in witness-box.—At a general court martial in 1941 a soldier was on trial for firing a rifle at a corporal. He pleaded that he had no memory of the affair and that he had suffered a head injury a few hours before the alleged incident. There was little clinical evidence to support his plea, but the attack appeared to be without motive, unpremeditated, and followed by singularly apathetic behaviour. Evidence that an electroencephalogram showed abnormalities concurrent with the man's plea of a head injury was admitted and the man discharged. In 1942 a man was tried at Winchester Assizes for a brutal and seemingly motiveless murder. His defence was that the act was committed in a state of post-epileptic confusion. Evidence was admitted to the effect that the prisoner's EEG was abnormal and that over-breathing brought out characteristics of an epileptic nature. His counsel contended that while a diagnosis of epilepsy could not be made on EEG alone, as no subclinical attacks were witnessed, an EEG as shown plus the behaviour described made a diagnosis of epilepsy extremely likely. The prisoner was found guilty but insane. Since these two cases similar evidence has been brought forward in several cases, and it has been accepted in the courts of the U.S.A. for some time past. In a leader in the *Lancet* (9) it is pointed out that the electroencephalogram does not show characteristic changes in every case of epilepsy, and subclinical attacks are only seen in a minority of epileptics.

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Further, an abnormal EEG may be found in non-epileptic relatives of epileptics (10), and in unstable people such as psychopaths (11), criminal delinquents, some psychotics, and even constitutionally disposed neurotics (12). Hill (11) has pointed out that since a large proportion of murderers may be presumed to have unstable temperaments and therefore probably abnormal EEGs the value of the test is reduced, as of course psychopathic personality is no defence in law. He therefore rightly urges that the method should be used with the greatest conservatism. On the other hand radiology and serology, with all their pitfalls, are recognized by the courts as capable of providing corroborative evidence of certain facts, and it would seem that the limitations of the EEG are sufficiently understood for it to be used in the same way. It has already been accepted as corroborative evidence of head injury and will doubtless be in common use in compensation cases. The *Lancet* points out that, given the apparatus it is easy to obtain a record, and anyone who claims to be competent enough to give an opinion has few to criticize him, so that the method presents a fertile field for the unscrupulous. It emphasizes that steps should be taken to safeguard its use in courts of law.

The most recent criminal trial in England where the electroencephalogram was used was in March, 1943, at the trial of Derek Lees-Smith, charged with the murder of his mother. It was known that he had drunk four pints of beer prior to committing the crime. Dr. John Hill and Dr. William Sargant gave him this quantity of beer and found that it lowered his blood-sugar level, and further, that his EEG showed abnormalities when his blood sugar was reduced. The jury studied the charts of the above tests when they retired to consider the verdict, and contrary to the summing up of the judge found the prisoner guilty of the murder, but insane when he committed the crime. The *Lancet*, in reviewing the case, remarks that the result would probably have been much the same if a simple verdict of guilty had been brought in, viz. detention during His Majesty's pleasure (13).

Traumatic neurosis; damages.—In Liffen *v.* Watson, 1940, Lord Justice Slesser, an expert in compensation cases, gave a judgment which should stand as a classical explanation of this syndrome. The case was that of a girl injured in a taxi accident, and the judge who first heard the case took what might be regarded as the ordinary layman's point of view. He held that the girl had been preoccupied for three years with her illness, whereas if she had made a determined effort to get back to the normal life of a normal active young woman, and if she had been compelled to do so by circumstances, there was nothing in the world to prevent it. He was satisfied that if she would only make up her mind to it, she could be back at work and living a normal life within two months of the action. He awarded her £300 and she appealed on the ground that this sum was insufficient. Lord Justice Slesser said that as a result of the accident she had a neurosis and she had pains, which, though they were not caused by any organic trouble, were yet real. He found no evidence that she would recover within a short time. It was begging the question to say that she would recover if she made an effort, for it was part of the neurosis that she should feel that she could not make the effort. There was abundant evidence that she was suffering from continuous pain. If, as

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she said, she could avoid the pain by not doing certain things, then she had been damaged because she could not do them. If she attempted them and had pain that pain caused her much suffering. He ordered a new trial. There is little doubt that in future Courts will be guided by this expert ruling in cases of traumatic neurosis.

The law will award damages, if negligence be proved, for psychical as well as physical damage. It would appear from recent cases that this doctrine is being extended to an absurd degree. In Hambrook *v.* Stiles, 1925, a lorry driver negligently allowed his lorry to run away down a hill. A woman who knew that her child was playing down the hill saw the occurrence and suffered a nervous shock with subsequent neurosis for which she got damages. In Owens *v.* Liverpool Corporation, 1938 (14), certain mourners were awarded damages for the shock resulting from seeing the coffin nearly thrown into the road as a result of a collision between the hearse and a tramcar. In Englestown *v.* Shead and Harding, 1941 (15), a lady witnessed a collision between a motor car and a lorry and was awarded damages for subsequent hysteria against the negligent car driver. These findings surely suggest an unwarranted extension of the principle of law that a man should be deemed to intend the ordinary and natural consequences of his acts and certainly such findings tend to the manufacture of neurotics.

The McNaghten rules.—Psychiatrists continue to try and convince judges of the inadequacy of the McNaghten rules as a guide to responsibility in crime. In R. *v.* Lockhart, 1939 (16), Sergeant A. M. Sullivan, K.C., supported by prominent psychiatrists, asked for a verdict of "not guilty" and not "guilty but insane" on the grounds that the condition of the prisoner at the time of murdering his wife was not one of insanity, but of temporary unconsciousness, this being his description of what the psychiatrists for the defence had called "dissociation." The judge, in his summing up, rejected this plea because of the careful preparations made for the crime and for the subsequent settlement of his affairs. The prisoner, a doctor, had given his wife an injection of evipan, placed her and himself near a gas fire and turned on the tap. In the morning his servant found the wife dead and the prisoner unconscious. The judge repeated the McNaghten rule and the jury found the prisoner "Guilty but Insane." It would have been surprising if this case had converted a judge to a new conception of responsibility, as even if he had agreed to the plea of automatism or unconsciousness, he would presumably have regarded it as a manifestation of temporary insanity and therefore within the McNaghten rules.

This question of criminal responsibility is dealt with more fully in the present series of articles by Norwood East in *Crime and Delinquency.*

Detention under the finding "guilty but insane" (17).—The verdict "guilty but insane" entails detention as a criminal lunatic "during His Majesty's pleasure." "This finding," said Mr. Justice Hawke, "has the effect of a life sentence in a criminal lunatic asylum, but the person is constantly subjected to examination, and is released at the earliest moment that such a step can be taken with safety." Previously defending counsel preferred a verdict of "guilty" with a definite sentence to one of "guilty but insane" with its

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implied indefinite, probably lifelong detention amongst criminal lunatics "during his Majesty's pleasure."

"Nowadays," said Mr. Justice Hawke, "the same desire exists in the criminal as in the civil institution, namely to restore the prisoner to natural life in the outside world when this is deemed possible." In spite of this defending counsel remain loath to plead insanity except in the most serious crimes.

Infanticide.—The Infanticide Act, 1922, provided that a woman, convicted of killing her *newly born* child when the balance of her mind was disturbed by reason of the birth, could be found guilty of infanticide instead of murder. Infanticide is equivalent to manslaughter, and if he thinks fit the judge can bind the prisoner over or put her on probation. This Act was amended by the Infanticide Act, 1938. By this Act if a woman wilfully destroys her child *less than 12 months old*, but at the time of the act the balance of her mind was disturbed by reason of her not having recovered from the strain of the childbirth or subsequent lactation, she shall be convicted of manslaughter only, and if found guilty, the verdict shall be infanticide, guilty but insane, or concealment of birth. The 1938 Act therefore defined "newly born" and included the effects of lactation. As D. Harcourt Kitchin (18) points out, the Infanticide Acts would seem to show up the strictness and unreality of the legal criterion of responsibility. Why is it that if the prisoner's mind is unbalanced she is responsible for her act? The answer is that although her mind is unbalanced, the McNaghten rules are not satisfied and the person therefore remains responsible. Hence the need for special provision for this class of patient. At an infanticide trial at Norwich in 1940 (19) counsel tried to persuade the court to ignore this distinction. His point was that the prosecution to support the charge of infanticide had to prove that the woman's mind was unbalanced, and that it therefore at the same time necessarily proved that her act could not have been "wilful." He cited authority that a wilful act was deliberate and intentional and carried with it the mind of the doer. He admitted that if he was right, no one could be convicted under the Infanticide Act. The judge directed the jury that they were entitled to find that the accused caused the death of her child by a wilful act, and also that the balance of her mind was disturbed, and that if they found these facts proved they should bring in a verdict of guilty of infanticide.

Summary.

Matrimonial Services Act, 1937 (Herbert Act).
Criminal Justice Bill (Sir Samuel Hoare).
Feversham Report.
Divorce legislation in Scotland.
Assault by mental defective on probation.
Detention of mental defectives. Amending Act to M.D. Act 1913.
Testamentary capacity.
Electroencephalogram in witness box.
Traumatic neurosis. Damages.
The McNaghten rules.

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Detention under the finding "Guilty but Insane."
The Infanticide Act, 1938.

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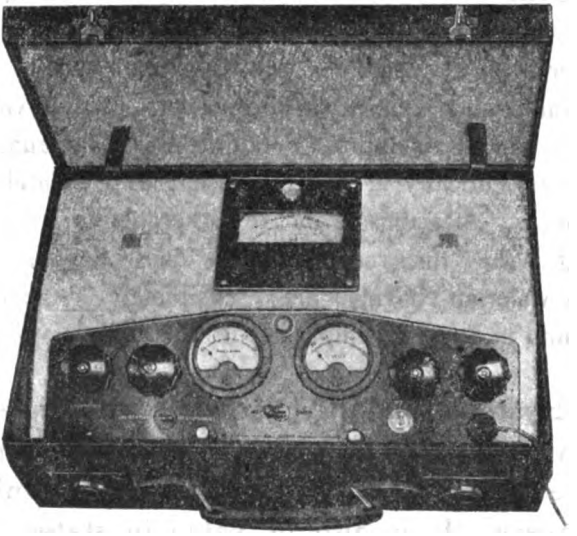

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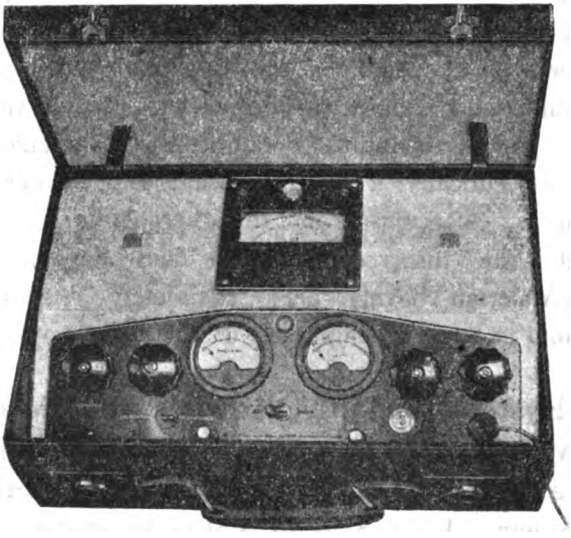

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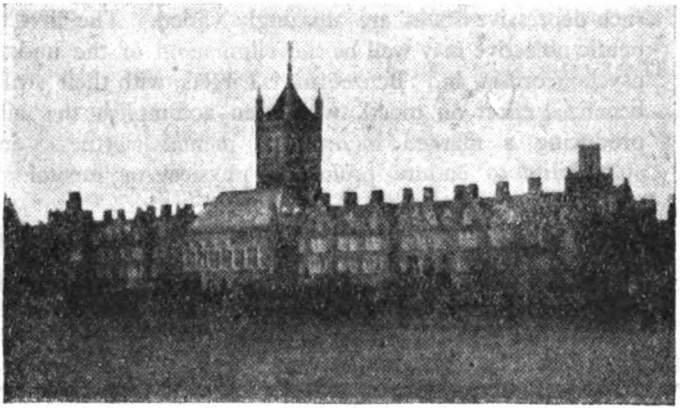

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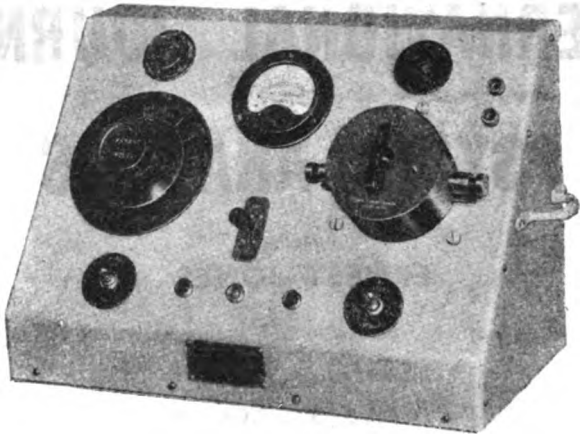

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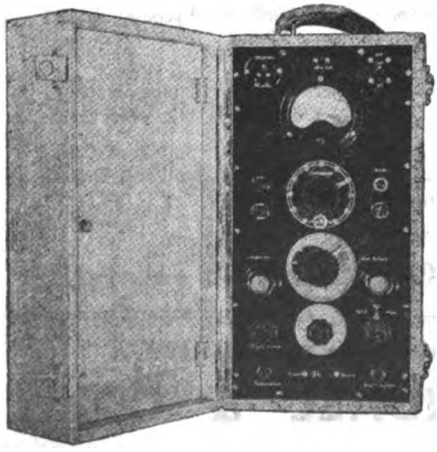

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